The FOUNDRY

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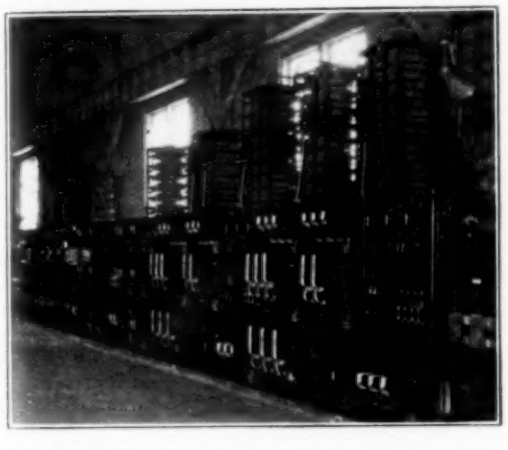
Castings Aid in Controlling Electrical Equipment

ANY study of the behavior of electrical energy emphasizes the importance of resistance in its relationship to other electrical units. Among other things, resistance is a necessary factor in controlling the voltage in numerous types of electrical equipment used extensively in industrial work. Series motors, such as are employed in electric railway service and on cranes and hoists, are controlled in part by resistance introduced in series with the armature circuit. Resistance also is



Cast Grids Mounted in Tiers Above the Regulating Panels Are Used to Control the Voltage

required in other types of industrial control apparatus, such as is installed in steel mills where practice requires that the motors be started, stopped and reversed quickly. Many of the resistance units included in these various types of control apparatus are assembled from a number of metal grids, the product of the foundry. A tough, free flowing gray iron has been used in the manufacture of these grids and in recent years some foundrymen have adopted the practice of adding approximately 5 per cent nickel to the iron to obtain the desired properties. Alloy steel also is used for making resistance grids and for electric heating grids. The grids are assembled into units in pressed steel supports and are insulated by mica tubes and washers.

Find Where Castings May Be Sold.

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An Engineer Visualizes

By E.A.Custer, Jr.

A DECADE or more ago an enterprising and far seeing engineer, with all the assurance that comes with conviction and with expectations warranted by investigations, built a foundry. He was feeling the first touch of that dearth of the old-time, all-around foundryman of yesterday which was just appearing as a menace then and which has grown to such an absolute and unquestioned barrier to the best operation of our foundries today. Every time the destiny, the fate or the jinx that ruled over his foundry took from him one of his old and capable molders he found it increasingly hard to find a man capable to replace him. Little by little the product of his foundry slipped back in quality and quantity as it had done in all other foundries.

The molding machine, in its various forms, had made its appearance and in many plants the machine operator at a lesser wage and with lesser foundry intelligence was rapidly replacing the competent molder. Labor-saving features, mechanical exactness and larger outputs everywhere were being applied to restore the lost prestige the foundries needed so badly.

This engineer was looking still deeper into the future and he reasoned well. If the molding machine took from the molder most of his skill and placed it in the category of a mechanical science, why could not the other elements that enter into the production of a casting be divested of their dependence on the human element and placed in the field of mechanical devices?

He designed and built his foundry. Not one single element was left either to chance or human skill. Each and every step was planned, plotted and synchronized. The mechanical contrivances were startlingly original and were constructed with laboratory preciseness. There was to be an output of 100 tons per day of small to medium castings and there was to be scarcely more than 10 men employed on all the production of these castings.

This foundry was designed almost with the idea of going in the front door, pushing a button, and going out back to see the castings drop out. The two cupolas were devoid of platforms and men and were 100 per cent mechanically charged. The charges were specific and almost absolute both in weight and analysis and the product correspondingly exact in analysis and temperature. The sand was mechanically handled, mixed humidified, aerated and blended and delivered to the big multiple molding machines where copes and drags were alternately filled, jolted, squeezed and stripped in their continuous journey through the shop. Huge conveyors, some horizontal and others vertical, combined with blower lines, exhaust lines, motors.

BASING his opinion on past performance and present conditions, E. A. Custer Jr., a well-known industrial engineer with extended foundry experience, takes a courageous gaze into the future and presents an interesting picture of the equipment and methods that will be used for the production of an ideal cast iron. He believes that cast iron through sheer merit will engage the attention of engineers and once more take its rightful place in a market that in recent years has been invaded to a certain extent by other products.

The author claims that all the statements he makes are based on facts. The foundry to which he refers was built in 1910 *and operated for some time. German foundrymen have developed a metal approximating the metal he describes. The article will be presented in two instalments.*

FOUNDRIES of the FUTURE

fans and a myriad of pipe lines presented an appearance totally strange and out of place in a foundry.

When it was completed, and had gone through the period of trials, troubles and agonies, it worked. For a time it turned out castings of an unbelievable quality and uniformity. It gave unquestioned proof that the basic idea was sound. It proved that our foundries, even today, are still on the threshold of modern achievement and that the engineer will surely supplant the foundryman in the foundries just as he has supplanted the artisan in other fields of production by the development of the automatic means of manufacturing.

Then came one of those periods of depression that leave in their wake a long list of enterprises forced to close their doors because of lack of market for their product or for lack of sufficient funds to tide over. This particular foundry blazing the way to a new era in the production of castings, fell by the wayside.

Production of Pig Iron

Since then, even under the spur of the tremendous demands of war, when everything took a great spurt forward and money was no object, the foundries have been sorely lacking in the efforts to keep abreast of the march of progress. Here and there the more progressive foundries have adopted some of the elements that go to scientific production of iron castings. Advent of the conveyor back in 1887 is almost forgotten. They are scattered all over the country, yet today a tremendous number of men still regard them as newfangled and novel and a goodly proportion ridicule them or at least avoid them as something yet to be proved.

Laboratory control of the cupola is progressing almost daily yet through the length and breadth of the country not a single foundry is selling castings under close chemical specifications. Steel has been bought and sold for years under the closest specifications and cast iron is the mother of steel.

According to recent tabulations, production of iron castings is becoming proportionately less each year, compared to the amount of pig iron produced. Production of pig iron has increased over 200 per cent in the past 25 years. During the same time the production of iron castings only has increased a little over 40 per cent. These figures include the huge volume of iron castings absorbed annually by automobiles and automotive equipment.

To some extent this condition may be traced to the inroads of steel stampings and forgings, and to the trend of the designers and engineers with an eye to safety factors and durability who hesitate to assume responsibility for a product that may or may not satisfy their requirements. Yet these same engineers are free to state that if a cast iron were to be produced that could be relied upon for uniformity, strength and permanence, they would not hesitate to substitute it for many of the present forgings and stampings.

Today foundrymen are facing a crisis. Burdened with an unsatisfactory product and with unreasonably high production costs, they have reached the fork in the road. The signboards are clear and unmistakable; to the right—REVAMP—to the left—RETIRE. Either change methods, equipment and policy and travel upward to supremacy and success; or slip down slowly but surely from stability and profit, to uncertainty and passed dividends. Finally to reach the stage of only memory if not oblivion.

Let's look ahead a bit and see what it means

to travel this road to the right. Let us paint a picture, or if you will, let us dream a dream. Neither a mirage nor a nightmare, but something plausible and within reason. Something for engineers, foundrymen, scientists and metallurgists to think and ponder over, something to put the foundries back where they belong and once were, at the head of the metal field, or better—something to shoot at.

Suppose we settle back in our swivels, perch our heels on the desk corner, light up our favorite soothing brand and with half closed eyes slip out quietly to visit this foundry of tomorrow.

At the first glance it doesn't look so much different from the familiar group of clean, orderly buildings adjacent to the railroad lines, with the big storage yard close to the largest building. The storage yard is entirely under crane runs. The busy cranes, with their huge magnets, are weaving in and out, up and down, with a regularity and rhythm that reflects a schedule demanding continuity and the closest synchronism. Some cranes seem to be sorting or classifying the metal. Some pig is placed here, some there, one grade of scrap accumulating in one location, other grades in other seemingly designated locations. Other cranes are taking some from this pile and some from that, and dropping their loads into three odd looking furnaces. Strange how they are so certain yet so apparently indifferent to precise quantity or quality. We hunt up the man of tomorrow and listen to the following description as he takes us point by point from the raw materials to the finished product.

"We simply had to develop a metal that could be depended upon absolutely for uniformity and regularity, and one sufficiently superior to the old fashioned cast iron to warrant its acceptance and use where strength, durability and safety were concerned. We turned to that metal first brought over here from Europe in 1926. You remember, it was used first so successfully in the production of diesel engine cylinders and other difficult castings. Well! We have developed it into a mighty good and safe material.

"Essentially it is cast iron, of the same ingredients, costing no more in raw material prices and but a little more in production when melted the same as cast iron. It is far better than the old cast iron, much stronger in tensile strength, with a limit of elasticity about the same as the ultimate rupture point of malleable and a breaking point considerably above that of malleable. However, it does not have the elasticity of malleable, having scarcely 2 per cent, but with its strength this is sufficient to warrant its use in most any place where malleable is used.

"Its remarkable superiority lies in the fact that it is absolutely uniform in hardness and in its expansion and contraction irrespective of the size, shape or section of the casting. It machines with the same ease as a good grade of cast iron but the absolute uniformity in all parts of the casting causes far less tool damage and consequently permits somewhat higher speeds. Resistance to impact is greater than in malleable and ability to withstand friction or abrasion is astoundingly greater than in cast iron. So you can see how easy it was to bring back to the foundry many of those castings that had left for the fields of stampings and forgings.

"To produce this metal with the consistency and accuracy required we had to make many drastic changes. We could not afford to pass up a single labor-saving device for that historical expression, 'Coolidge Economy' was a joke compared to the conditions we had to meet. Now let me show you how we do it.

Powdered Coal

"Cranes are in two classes. One group makes a rough sorting, by size, character and shape of the scrap, and assembles it into three general classes. Pig iron is known by grade and it is piled with one of the first three classes according to its grade. The other cranes are busy charging three powdered coal melters that were invented and developed in the Middle West back in 1927. One furnace is assigned to each of the three general classes of metal and the cranes simply take the raw materials as they come, their only duty is to supply the furnaces as fast as they will take it.

"These furnaces, combing the principles of the cupola and the air furnace, are rotary and entirely automatic. They are capable of melting any metal from lead to the finest alloy steel, at any speed from 1 ton per hour to 50, and at any temperature up to 3600 degrees Fahr. The air and coal controls automatically maintain a neutral flame, neither carburizing nor oxidizing. Intensity of the flame is synchronized with the speed of rotation of the furnace for every grade of metal to be melted.

"On the inside you will see molten metal running in a continuous stream from the three furnaces into three reservoir ladles, which in turn pour irregular quantities into this continuous furnace. That is the last step.

Trouble Shooters

"Come up in the control room and let me show you just how we keep our analysis at the precise and exact point that gives the splendid all-around, uniform metal. One entire side of this room is a large panel on which are mounted this host of dials, indicators and gages with here and there a rheostat or a switch. Most of these dials and indicators are merely indicators or, as we call them, *trouble shooters*. They register coal and air pressures, flame temperatures and furnace speeds, and are only consulted to locate instantly the cause for any trouble.

"Eight dials in the center give us our real metal control. Four are temperature recorders connected with the three reservoir ladles and with the final ladle that receives the metal from the last prehating furnace. Each of these four dials is equipped with an adjustable thermostat set to the desired temperature. Through a series of relays it operates the mechanism that governs the melting temperature. Within slight deviations, we always maintain the metal in the reservoirs at just the temperature we want.

"Before we came up here, I should have pointed out that the melting speed of each furnace is governed from the receiving ladles on each furnace. The trunnions of these ladles are mounted on compensators that in turn regulate the speed of the revolution of the furnace and consequently the speed of melting. The furnace automatically picks up or loses speed as the metal is taken fast or slow.

"These other four oval shaped dials constitute the real control. They look more like highly complicated charts than recording dials. Well—its going to be rather hard to give more than a sketchy idea of the principle on which they operate, for I am not as well grounded on that as I should be. They are based on, and as a result of, the remarkable discoveries and revelations that Walter Russel, the great scientist, brought out in 1926 and 1927. You remember, he gave us the new unity conception, rearrangement of our or-

(*Concluded on Page* 815)

Paris Exhibition Features Foundry Equipment

By Vincent Delport
European Manager, THE FOUNDRY

VISITORS from the principal industrial countries of Europe attended the international foundry exhibition organized by the Syndicat Général des Fondeurs de France, at the exhibition grounds, Paris, from Sept. 1 to Sept. 21. The show was the largest of its kind ever held in France, and probably the largest in Europe. The exhibits of foundry products, ranging from industrial castings to works of art, were particularly striking, while the section devoted to foundry equipment was truly representative of the state of the foundry industries in Europe at the present day. The exhibits occupied 161,460 square feet, of which 107,640 were covered. There were over 300 exhibitors, and several countries were represented. Considerable space was devoted to technical exhibits and a stand showed the history of the foundry industry.

Foundry machinery was operating in an open space, between the two large halls where the following sections were arranged: Foundry equipment and technical education, iron and steel castings, heating apparatus, bronze and aluminum, raw materials, the retrospective exhibit. Certain foreign countries had a section to themselves. Belgium showed samples of sands, castings made at the principal iron and steel plants, sand preparing machinery and cast iron pipes. Italy exhibited steel castings made in the electric furnace and cylinder castings from the leading automobile manufacturers. Some castings made in Spain were displayed in the section reserved for that country.

The principal works associated with the Comité des Forges and those controlled by Arbed and Terres-Rouges in Luxemburg displayed some heavy castings, such as rolls, cylinder castings for diesel engines, locomotive castings, etc. The section devoted to technical education was of considerable interest. Photographs and charts showed schedules of studies of the leading schools in France, including the Ecole Supérieure de Fonderie and the Ecole Centrale des Arts et Manufactures. Czecho-Slovakia, Germany and Belgium each had a section in which the methods of technical education followed in those countries were displayed. Samples of castings and patterns made by apprentices also were shown. One stand was devoted to the technical press and presented copies of the leading technical and trade papers of the world, dealing with the foundry and the iron and steel industries.

The exhibition was organized under the patronage of the French government, and the formal opening was effected by M. Queuille, minister of agriculture. The Spanish, Italian and Belgian governments also gave their support in the organization of the foreign sections. Among the numerous exhibits pertaining especially to foundry equipment, a few novelties and improvements, were noticeable. Several types of American machinery were shown. A complete model on a reduced scale showed the new Citroen foundries recently placed in commission at Clichy near Paris.

A VARIETY OF FOUNDRY EQUIPMENT WAS EXHIBITED BY AMERICAN MANUFACTURERS

An unusual molding machine was that displayed by the Société Anonyme des Usines de Rosieres, Bourges, France. Six tables travel along a continuous circuit. The flasks are placed on these tables which pass under a sand hopper, then under a set of three rolls that press the sand, following which a traveling crane lifts the flask and conveys it to the pouring station. The empty flasks are taken back to the circuit by another monorail. The operations are continuous and automatic and are especially designed for the manufacture of stove castings in large quantities. The Badische Maschinenfabrik, Durlach, Germany, had a large exhibit comprising an automatic sand preparing plant, sand conveyors, shaking-out equipment and molding machines. These machines all were operating. The company displayed a new type of machine for filling and ramming sand in large flasks. The sand is projected into the flask by a current of compressed air, and its density can be regulated. The sand is projected through a nozzle fixed at the end of a flexible tube. It is fed into a reservoir by a hopper and a slowly rotating table. The speed of feeding into the flask attains 300 liters per minute. The length of the flexible tube may attain 20 meters.

The Vereinigte Schmirgel und Maschinen Fabriken, Hannover, Germany exhibited several molding machines with automatic sand feeding, all these machines being operated by air. L'Outillage de Fonderie, rue Grétry, Paris, agents for France, Belgium and Luxemburg of the line of molding machines manufactured by the Tabor Mfg. Co., Philadelphia, demonstrated a number of these machines, including a heavy jolt ramming machine. The same firm also exhibited their mold and core ovens heated by coke powder. They showed a new hand molding machine in which the mold is drawn from the bottom, and a sand mill where the usual runners are replaced by disks. Société Anonyme Fenwick Frères, 8 rue de Rocroy, Paris, showed two sand throwing machines made by the Beardsley & Piper Co., Chicago, one of the tractor type, the other of the portable type on wheels. These machines were shown working on various patterns. They also displayed several sand separators, manufactured by the Royer Foundry & Machine Co., Wilkes Barre, Pa., an air operated core blowing machine made by Wm. Demmler and Bros., Kewanee, Ill., and one moisture meter for sand built by the R. W. McIlvaine Co., Chicago. The Allied Machinery Company, 19 rue de Rocroy, Paris, exhibited one jolt ramming rollover molding machine, one jolt ramming machine, one jolt rollover machine, and one small jolt ramming machine with stripping plate for snap flasks, all made by the Osborn Mfg. Co., Cleveland. The Allied company also showed one sand aerating and desintegrating machine. The Etablissements Glaenzer et Perreaud, Faubourg du Temple, Paris, showed several molding machines, including a jolt ramming machine and a jolt ramming machine with special magnetic table, which were made by the Wm. H. Nicholls Co., Inc., Brooklyn, N. Y.

Ph. Bonvillian et E. Ronceray, Choisy-le-Roi, near Paris, had erected a complete foundry in working order at the entrance of the exhibition. Seven molding machines of various types made by the firm were used. Molds were conveyed to a pouring station by a roller conveyor, located close to the cupola. The ladles were transported by monorail. After having been poured the molds were taken by monorail to a shake-out station, the distance from the melting station allowing the castings to cool sufficiently. The castings then were taken to the sandblast and cleaning apparatus. The sand plant also was complete, and the sand was conveyed to the molding machines on a belt conveyor. A one-ton cupola with charging platform and elevator was blown by an electric blower. Several tons of castings were made. Société Anonyme de Constructions Mécaniques Duplex, rue Lafayette, Paris, displayed several molding machines, one of which is especially constructed for the mass production of tall castings with heavy cores such as large pans, etc. The machine is supported by a heavy arm which rotates by two hydraulic pistons, chain and gear, which enables the whole machine to turn completely round. Other molding machines were displayed by La Construction Moderne de Matériel de Fonderie, Drancy, Seine; Société Parisienne de Matériel de Fonderie, 61 rue Servan, Paris; Fernand Perdrizet, agent for Alfred Gutmann, Ottensen, Hambourg. Fernand Perdrizet who is located on rue de Chabrol, Paris, also exhibited sand blast equipment.

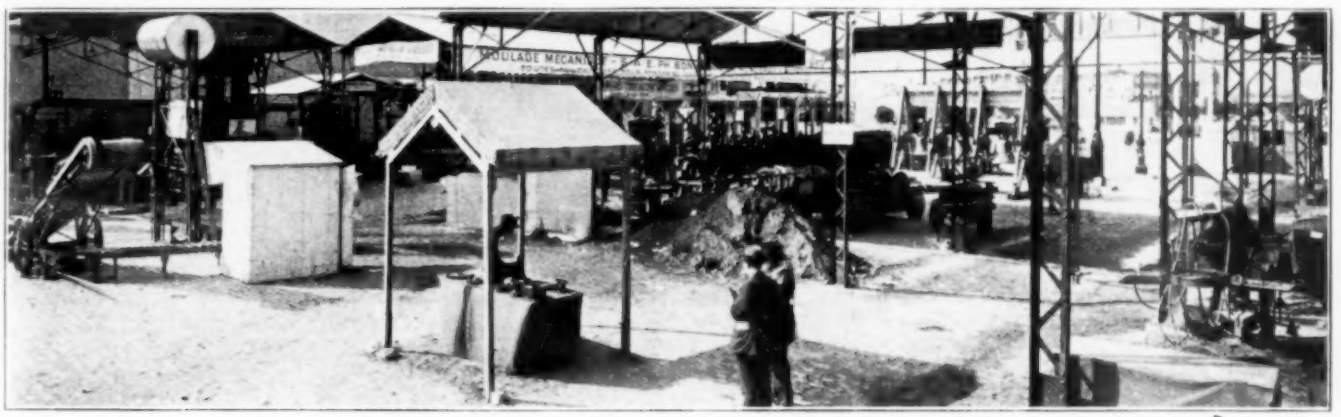
Many exhibits concerned sand preparation. T. Ketin and R. Thiriart, Sclessin-lez-Liège, Belgium showed an automatic and transportable sand mill comprising a rotating sieve for the used sand, a mixer, a mill with conical runners, and a disintegrator with a fixed and mobile disk. One man can produce from 2½ to 3 tons of

MACHINERY WAS SHOWN FOR PERFORMING PRACTICALLY ALL FOUNDRY OPERATIONS

prepared sand per hour. The same firm also showed a cupola of a rotating type. Etablissements A. Sisson-Lehmann, Charleville, Ardennes, France, displayed a sandblast rotating machine which can clean from 1540 to 2640 pounds of castings according to their size, and compressors built for this machine. A cleaning barrel for small castings and some hand molding machines also were shown. Alfred Baillot & Cie., Saint-Ouen-sur-Seine, near Paris, exhibited a semiautomatic sand plant with a rotating pan of 6.9 feet in diameter. The sand automatically is emptied through the center of the pan. The machine is fed by three distributors, one for the used sand, one for the new sand and the third one for mineral blacking. This firm also showed sand handling and transporting equipment and a range of hydraulic molding machines. E. Gernelle-Danloy, Rouen, France, showed a sand mill in which the suspension of the runners is adjustable to prevent the silica in the sand from being crushed. These mills are made in three sizes, the diameter of the pan of the smallest size being 4.2 feet and that of the largest 6.85 feet. The Chicago Pneumatique, rue Alibert, Paris, displayed vibrating sieves, pneumatic tools and air compressors. A. Savy, Jeanjean et Cie., Courbevoie, near Paris, showed a sand mixer and disintegrator for preparing core sand.

Société des Etablissements A. Utard, Longeville-en-Barrois, Meuse, exhibited hand molding machines, pneumatic and hydraulic machines, a universal sand mill operated by a 5-horsepower motor, which divides and mixes the sand. This mill can be combined with a shake-out machine. Thivet-Hanctin, Saint-Denis, Paris also showed a sand mill with spherical cage and a mill for foundry blacking. Société l'Avébène, rue d'Aguesseau, Paris, displayed samples of cores made with its special binder. In addition to the firms mentioned above, of which a number displayed foundry equipment such as cupolas, core ovens, blowers, etc., several concerns specializing in this class of work also showed their products. Air compressors were demonstrated by Les Nouvelles Usines Bollinckx, Buysinghen-lez-Bruxelles, Belgium. Société d'Etudes et de Constructions Métallurgiques, rue La Boétie, Paris, exhibited an electric furnace with rotating arc. Fours Pénicud, Bagnolet, near Paris, displayed rotary furnaces of 220 and 440 pounds, heated with coke; oil fired furnaces for melting aluminum, and refractories. Oil fired furnaces were also shown by Louis Hirsch & Cie., Bagnolet, near Paris. A rotating furnace which can be operated by one man was demonstrated by Etablissements Marshall, rue du Pont-aux-Choux, Paris. Matériel Electrique de Contrôle et Industriel, rue du Faubourg Poissonnière, Paris, exhibited electric furnaces and some pyrometers.

The firm of Guilliet Fils et Cie., Auxerre, Yonne, France, displayed a complete range of woodworking machinery. A number of exhibits showed various types of conveyors. The adoption of mechanical means of transportation in Europe has caused a development in that type of equipment. Displays of measuring instruments, testing apparatus, small tools and equipment were also numerous. Aciéries Thomé-Cromback, Stains, near Paris, showed examples of their various sizes and grades of steel balls.



THREE HUNDRED COMPANIES MAINTAI NED EXHIBITS AT THE PARIS SHOW

Officers Are Elected

Anderson Stove Co., Anderson, Ind., has elected officers at a special meeting of the board of directors. William C. Quinn is the new president and Jacob Teller was elected chairman of the board.

International Committee Meets in Paris

On Saturday, Sept. 10, at the close of the foundry convention which was held in Paris, the members of the International committee of foundry associations held a meeting, Paul Ropsy, president of the Belgian Foundry association being in the chair. The following countries were represented: Czecho-Slovakia, Germany, Great Britain, Holland, Belgium, Italy, Luxemburg, Spain Switzerland, France and the United States.

After the announcement that the American Foundrymen's association had become a member of the committee, the officers for 1928 were elected. Dr. Siegfried Werner, president of the Verein Deutscher Eisengiessereien, Dusseldorf, the present vice-president will take office as president on Jan. 1, 1928. Stuart Wells Utley, president of the American Foundrymen's association, was nominated as vice-president and prospective president for 1929, when the next big international congress will take place in London, England.

J. Espana, representing the Spanish foundrymen officially invited the foreign associations to attend a foundry convention which will take place in Barcelona, Spain, in April 1928. This convention will be followed by a tour of inspection which will cover the best part of Spain. Carlo Vanzetti, representing the Italian foundrymen announced that following the convention to be held in Belgium in 1930, the foreign associations will be invited to attend a convention in Italy in 1931.

Dr. Werner announced that a technical exhibition will be held in Dusseldorf, Germany, in October. Professor Pisek, president of the Czech association suggested that the International committee of foundry associations should prepare a dictionary of foundry terms in as many lan-

guages as possible, including Esperanto. It was decided that the president of the committee would communicate with the various organs interested and that the question would be discussed at the next meeting.

The members of the International committee of foundry associations will next meet in Barcelona, Spain, in April 1928. The American Foundrymen's association is represented on the Committee by H. Cole Estep, chairman of the committee of international relations, and by V. Delport, European member. The permanent secretary of the committee is T. Makemson, St. John's street chambers, Deansgate, Manchester, England.

Foundrymen Study Problems

CONSIDERABLE importance was attached to the foundry convention organized by the Association Technique de Fonderie de Paris and held in conjunction with the international exhibition, which caused hundreds of visitors to come from the four corners of Europe. The convention was opened on Sept. 7, at the exhibition grounds just outside Paris, by M. Luc, inspector-general of technical education, who was delegated by the minister of public instruction. Léon Thomas, general manager of the Citroen foundries, held the chair in his capacity of president of the French technical association. The guest of honor during the congress was Paul Ropsy, president of the International committee of foundry associations and president of the Belgian association. The presidents or vice presidents of the associations of foundrymen of Czecho-Slovakia, Germany, Great Britain, Holland, Italy, Luxemburg, Spain also were present.

In the opening addresses made by Léon Thomas, M. Luc and Paul Ropsy, stress was laid on the influence of science and research on progress made during recent years in obtaining high duty castings. They emphasized the fact that progress in the industry is due to interchange of information and to close contacts between the various associations. Great progress also has been made in developing foundry-foremen and engineers and in creating a special branch of technical and practical studies in various engineering schools.

Eighteen papers were presented during the convention, including exchange papers contributed by the American Foundrymen's association, the Institute of British Foundrymen, the German Foundry associations, the Czech association, and the Association Technique de Fonderie de Belgique. A paper also was presented by Giulio Sirowich, professor of the Royal School of Engineers, Rome, Italy.

Wednesday afternoon, Sept. 7, the exhibition was officially opened by M. Queuille, minister of agriculture. In the evening a reception, followed by a dance, was held in the building of Engineers of the Ecoles Nationales d'Arts et Métiers. Thursday morning was devoted to technical sessions and in the afternoon the Ecole Supérieure de Fonderie formally was inaugurated. On that occasion the new extensions of the school were visited. Technical sessions were held on Friday and Saturday morning, and in the afternoon various works were visited in the vicinity of Paris. On Saturday evening a banquet was held at which over 250 guests were present. Edouard Herriot, minister of Public Instruction, presided.

Immediately after the formal opening of the congress, the first paper was presented in full session by Henri Magdelénat, vice-president of the association, and managing director of the Usines de Rosières, Bourges. The subject of the paper was "The Rational Organization of Foundries". The author dwelt particularly on the necessity of all operations being effected mechanically. He stated that it is difficult in France to install complete mass production methods due to the lack of standardization. Discussing the subject, E. V. Ronceray said that he had more in mind the organization of foundries according to their individual conditions. The operation of any plant always may be improved, and it is necessary to show what can be effected in certain specific cases. M. Ronceray, M. Thomas and M. Magdelénat all agreed that they had found no difficulties in making their workmen accept new methods, as long as their rates of pay were not diminished.

"Simple and Rapid Methods for Controlling the Mechanical Properties and the Structure of Castings", was the subject of a paper presented by Professor Girardet. The author casts small bosses with the piece. These bosses are of a thickness corresponding to that of the part of the casting with which they are cast, they are detached from the casting and small test pieces are taken from them. The test pieces are from 15 to 20 millimeters long and their section is 25 square millimeters. All the various tests are effected on these pieces which are taken from different parts of the casting. A. Portevin, in the discussion, emphasized the advantage of making several hardness tests in the vicinity of the same point with a small ball, such as the one used in the tests described in the paper. M. Girardet stated that he also has made a special machine of small dimensions for the shock tests. A. Le Thomas, chief engineer of the navy, said that the shock test can give reliable information only if the test piece has been cast with the casting. He believes that M. Girardet is on the right track, and said that it is advisable to use testing specimens, the dimensions of which are in proportion with the results that are to be obtained. M. Portevin said that the shock test is a dangerous one and concurred with M. Le Thomas in the necessity of taking the test piece from the casting. He said that before a standard specification of shock test is arrived at, many experimental results must be obtained first. During the morning the German and Italian delegates each held a separate session in their respective languages in the form of a round table discussion.

On Thursday, Sept. 8, Paul Ropsy opened the session in which the exchange paper of the German associations was presented by Dr. Prof. Schüz, on "The Eutectic Graphite of Gray Cast Iron". The author who has made a special study of the subject revised the work made by his predecessors. He pointed out that ten years ago the maximum strength of cast iron was 24 kilos per square millimeter, whereas to-day one commonly obtains 40 kilograms. He has investigated the way of obtaining methodically eutectic graphite with the finest possible grain. Satisfactory results have been obtained, but Dr. Schüz concluded by saying that it should be possible in the future to obtain shades of cast iron, from ferrite to pearlite, in which free carbon could be separated, not by annealing, as in malleable iron, but during the first cooling. Replying to Professor Portevin, Dr. Schüz said that he had

obtained results at a temperature in the cupola of 1350 degrees Cent., a minimum of 3 per cent silicon and casting in chill molds. He obtained castings of a maximum thickness of 50 millimeters, with from 0.20 to 1 per cent manganese.

The next paper was "A Curious Example of Heat Treatment of Cast Iron", by A. Le Thomas and M. Domanski. The authors described the casting of a shaft, 2 meters long, and 560 millimeters in diameter with a disk of 800 millimeters diameter at each end. The piece was cast vertically. Some time after the mold was pound, the casting gave way, and some liquid iron remaining in the center of the piece ran out. Liquid iron then was poured into the hot mold formed by the first solidified iron and the structure of both metals was examined after solidification. The results of the investigation were described in the paper, showing that the properties of pearlitic cast iron can be modified by heat treatment after solidification. Following this contribution the exchange paper of the American Foundrymen's Association was read by Vincent Delport, European manager of THE FOUNDRY and member of the committee of international relations. The author of the paper was Jesse L. Jones, Westinghouse Electric & Mfg. Co., Pittsburgh, his subject being "Influence on the Quality of Cast Iron of the Addition of Iron and Steel Scrap in the Blast Furnace".

While these papers were being read, the following were discussed in another room: "The Organization of Work Planning in a Foundry", by A. Le Thomas, "The Determination of Production Costs in the Foundry", by R. Tocheport, foundry manager, Société de Constructions Métalliques, Dax, Landes, "The Breaking-up of Heavy Scrap", by M. Gautard, technical manager, Fonderies de Nord-Paris, la Courneuve, near Paris. At the same time a session in English, in the form of a round table discussion took place under the chairmanship of E. V. Ronceray. In the afternoon, following the inauguration of the Ecole Supérieure de Fonderie, Prof. Albert Portevin delivered a lecture in the new amphitheater, in which he reviewed the present state of knowledge in the macrostructure of nonferrous metals and their alloys, and its application to the foundry industry.

The exchange paper of the Belgian association was read on Friday, Sept. 9, the subject being "Some Testing Methods and Some Properties of Various Cast Irons", by P. Herman and Mademoiselle H. Henquin, engineers, Fabrique Nationale d'Armes de Guerre, Herstall lez-Liège, Belgium. The paper is the result of investigations made under the direction of the Belgian committee of testing cast iron. The autnors conclude that the results of several different tests must be obtained to arrive at a knowledge of a cast iron. They suggest the following order: Hardness test, micrographic examination, chemical analysis and shearing test. A. Le Thomas, opening the discussion said that opinions differ concerning the hardness test, but he does not think that they should be rejected. He alluded to the authors' method of shearing test, which they effect by punching a small cylindrical piece from the test bar. The speaker emphasized the fact that the results are different from those obtained with the ordinary machine. He further stated that the conclusions of the authors point toward the rejection of the shock test. M. Girardet, who has investigated testing methods, pointed out that when punching thick plates, the punched piece is not quite cylindrical, and if this is the case with cast iron, the results of the test cannot be convincing, but M. Carlier said that the punchings were found to be of a regular section. M. Le Thomas, referring to the heat treatment of cast iron said that it is interesting in two cases, first eliminating internal tensions, without changing the structure, secondly annealing to diminish the hardness. In any case, the temperature of the treatment should be exactly determined. A. Portevin, alluding to the new method of shearing test said that this only enabled one test to be made on the bar,whereas the Frémont test enables several tests to be made.

Giulio Sirowich, professor at the Royal school of engineers at Rome, Italy, presented his paper on "The Testing and Properties of Foundry Sands". In conclusion, the author said that the production of synthetic sand is possible and will be conducive to obtaining good castings. Carlo Vanzetti, professor at the Ecole Supérieure de Fonderie, read the paper of R. Lemoine, on "The Applications of the Electric Furnace in the Iron Foundry—The Duplex Processes". M. Vanzetti, who is managing director of the Steel Foundries of Milano, Italy, said that it saves electric current to first melt steel scrap in a cupola, with good coke, and then pour the molten metal in an electric furnace with an addition of iron ore. The economy of current is about 30 per cent, and the current is utilized in a regular manner. An advantage of the electric furnace is the ease of control during the operation. Replying to M. Barrière, Société Chenard et Walker, M. Vanzetti said that taking into account the cost and consumption of electrodes and the renewing of linings, the results obtained by the use of the process to date have encouraged him into extending the installation.

A Lévy, manager of the Fonderies de Saint-Nicolas, Revin, contributed a paper on "The Heredity of Cast Irons". Two irons with an identical composition and same graphite content may have different properties, according to the size of the graphite inclusions. The author believes that this is due to the size of the graphite in the original metal. A. Le Thomas said that experiments must be made to show that graphite can survive the melting. M. Barrière suggested that heredity might be traced as far back as the ore. M. Girardet said that in his opinion it always will be possible to destroy heredity by heating sufficiently. M. Barrière presented the request that the question of heredity should be investigated and that the results obtained, either in France or in foreign countries, should be collected and published. Prof. F. Pisek, Ecole Polytechnique de Brno, Czecho-Slovakia, presented the exchange paper from that country, entitled "Contribution to the Question of Testing of Cast iron". A. Le Thomas then abstracted his paper on "Certain Properties of Special Brasses with Nickel and Manganese Contents."

Concurrently with this session the following papers also were read: "The Influence of Alumina on the Pouring of Aluminum", by E. Renaud, "The Electric Melting of Copper Alloys", by P. Lemoine, professor at the Ecole Supérieure de Fonderie, and consulting engineer. A Spanish session was held under the chairmanship of J. Espana. During the week those interested in special subjects were grouped at lunch, and special lunches were also organized for delegates speaking the same language.

Desires Agencies

Art Engineering & Trading Agency, Ahmedabad, India, exporters and importers and manufacturers agent, desires to get in touch with machine tool and hardware companies which wish to establish agencies. The firm wants catalogs, and list prices with the prices C. I. F. Bombay harbor. The Art Engineering & Trading Agency also is desirous of obtaining the agency for crucibles.

How Penn State

Teaches Employes at Home

By R. S. Kerns

AN EARLY English educator once said, "Though it may be impossible to bring the masses requiring education to the university, may it not be possible to bring the university to them?" This statement may be said to be the motto and aim of the department of engineering extension of the Pennsylvania State college.

The history of the growth of engineering extension education in Pennsylvania is a record, in effect, of the changing attitude of the employers and employes toward the whole idea of the necessity of education. The early experience of the college representatives was a succession of indifferent rebuffs, as call after call was made on skeptical employers, many of whom were actually antagonistic to any suggestion of training. The old time idea of a weak mind and a strong back as the proper equipment of a workman was, until a surprisingly recent time, commonly held.

The department of engineering extension finally became active in 1910 when a class was organized in shop drawing in Williamsport, Pa., by Dean John Price Jackson, working through the Williamsport school board. This venture proving highly successful, Dean Jackson next arranged in 1911 for the organization of an apprentice school in the Altoona shops of the Pennsylvania railroad as an extension activity. With the Pennsylvania State college cooperating, the entire scheme of apprentice instruction was developed, until it embraced every large railroad center of the system in its lines east of Pittsburgh.

Further work was done in connection with the Y. M. C. A.'s over the state, at Allentown, York, Reading, McKeesport, Wilkes-Barre and other industrial centers, until today the Pennsylvania State college reaches through the department of engineering extension over 8000 employes, as well as many employers.

The various methods of "Bringing the College of the State to the People of the State" may be listed as follows:

Organized class instruction.
Home study.
Correspondence.

Organized class instruction was the first method used by the department in its program of spreading education beyond the confines of the college campus. Briefly, the classes were secured as follows: A representative of the college calls on the management of an industry and shows the officials the type of instruction the department is prepared to give employes. This idea is presented to the men and, after showing them the advantages of further education in their line of work, a time is set for organizing the classes. A college instructor is detailed to assist in the organization and help the prospective students to decide from what courses they would receive the best results.

Classes then are held at stated intervals either in the shop or elsewhere, either on shop time or on the employes' time. The material supplied by the college is written in such a manner as to be readily understood by anyone who can read a newspaper. The examples all are practical and the instructor, in most cases a foreman or superintendent of the plant, is able to give the class first-hand information on everyday problems which they meet in their daily work.

Through years of experience, the department of engineering extension has developed a highly trained organization. It has prepared lesson material which has proved excellent for the average workman. Much of the theory is eliminated in the various engineering courses offered and more practical problems included, until now the average workman may secure a course in engineering almost equivalent to a four years course taken by resident study at the college, even though in many cases he is forced to discontinue his formal education at an early age.

Home Study

Class instruction has its undeniable merits and for a time it was the sole method followed. However, it became evident in some classes that various factors were to be considered and certain changes to be made in the the class organization. Among these factors was the unequal mental capacity of the students, which allowed some to advance more rapidly than the others. The brighter ones were held back with the slower members of the class, shifting hours of labor compelled some of the students to drop out of the classes and for various reasons the classes could not be held intact for the required period.

These disadvantages led to the popular home study groups which function as follows:

The students study at home, prepare their lessons and hand then to a person designated by the company. This company official, in turn, sends them to be corrected by instructors teaching the same subjects at the college. The students are brought together at times when all are able to attend, or they are permitted to present their problems, on shop time, to an instructor appointed by the management of the company. In this manner, each student is thrown upon his own initiative to carry on his studies as he has time, without relying on the speed of his friends and classmates.

Correspondence Instruction

The increasing number of requests from isolated individuals for the extension courses pointed to the desirability of organizing a correspondence section. Such instruction after a trial in 1917 and 1918 was fully inaugurated in 1919 and its incidental developments have been extremely important, particularly in the preparation of the extension department's own text books. The Pennsylvania State college through the department of engineering extension, as a result of these methods, has been able to teach successfully almost any subject which is practical and in demand by the people who cannot come to college.

For some time past, the department of engineering extension has been receiving calls for various courses in metallurgy for the practical shop man, courses that would devote more time to everyday shop problems and less to theory. As a result, three well-balanced courses have been prepared and received with open arms by industries and individuals, to be taken by correspondence or home study. They are divided as follows:

The practical heat treatment of steel.

Practical metallurgy for the steel foundryman.

Practical metallurgy for the gray iron foundryman.

The practical heat treament of steel is a course made up of 31 lessons. Such problems are covered as the de-

sign and operation of heat-treating furnaces; methods of placing charges in the various types of furnaces; securing maximum efficiency for the fuel used in heat-treating furnaces; forging temperatures and operations for various classes of steel; testing steels and the importance of the various tests; micro-structure obtained in low-, medium- and high-carbon steels after different heat-treatments; heat treatment of carbon and alloy steels to give desired qualities; case carburizing and thermal treatment to give a hard case and a tough core; microstructure of alloy steels and their heat-treatment to give desired qualities; recommended heat-treatments of various articles, as dies, gears, punches, tools, etc., and heat-treatments of high-speed steels. In fact, the field of heat-treating is well covered and questions and problems from the student are welcomed. The college department of metallurgy is cooperating with the department of engineering extension to carry out this educational program in metallurgy.

A course of 20 lessons, on steel foundry metallurgy is designed for the steel foundry employe and deals with such problems as steel foundry organization; operation and construction of open-hearths, crucible furnaces, bessemer converters and electric furnaces; calculating charges; making correct slags; chemistry of processes, etc. A portion of the course is devoted to design and placing of sink heads, risers, gates, chills, etc. in steel molding. Molding sands and steel foundry materials are discussed; annealing steel castings; welding and straightening steel castings; pyrometers and their uses; ladles and their care. Almost everything that confronts the steel foundryman, is discussed in this course.

The course for the gray iron foundryman consists of 20 lessons. It includes thorough treatments of such subjects as foundry organization; storage of materials; metallurgy of iron; influence of elements in cast iron; combustion, cupola and air furnace operation and design; foundry sands and materials; testing cast iron. The course contains many problems which illustrate the principles discussed in theory.

Another course has also been outlined which is more advanced and requires some knowledge of chemistry and it is probable that college credit will be given for this subject. This course contains such subjects as blast furnaces, the chemistry of their operation; all steel making furnaces and the chemistry of their operations; forging and rolling; metallurgy of iron and steel; heat treating; case hardening; tool steels and alloy steels. The entire field of ferrous metallurgy is covered.

A nominal charge is made for all courses taken by the methods mentioned above, a charge which is just sufficient to care for the cost of the text materials and the cost of correcting papers. A legislative appropriation enables the department of engineering extension to dispense with any charge for supervision. With these low fees, it is possible to give one subject or as many as the student wishes without confining him to a certain course, at a very small cost.

The success of the engineering extension department is best reflected by the growth, in the past ten years, of enrollments, increasing from a few hundred students in the shop courses to over 8000 at present taking 124 different subjects.

To Hold Conference

Preparations are advancing for the conference on engineering materials which will be held in Berlin, Germany, from Oct. 22 to Nov. 13. The sponsors of this conference are the German scientific engineering associations, industrial organizations and the exhibitions, fairs and foreign visitors' office, Berlin. A program consisting of 200 lectures presented by scientists and practical engineers has been arranged. The series of lectures will be held at the Technical University of Charlottenburg and an exhibition of engineering materials will be shown in the Neue Ausstellungshalle located on the Kaiserdamm. Three groups of engineering materials will be dealt with, namely, iron and steel, nonferrous metals and electrical insulation materials.

Submits Standards for Refractories

Recently the American Foundrymen's association has mailed to its members a report of the sub-committee on the survey of conditions in the malleable industry. This subcommittee is one of the several appointed by the joint committee on foundry refractories which is sponsored by 12 co-operating organizations.

In the survey it was found that producers of refractories listed 44 standard shapes of malleable refractories, not including innumerable special shapes made to order exclusive of tap-out blocks. The subcommittee has made definite recommendations that will reduce the number of sizes and shapes to a total of 24, including tap-out blocks as shown in the accompanying table and recommends that these be approved as tentative standards. Any criticisms or suggested changes should be sent to James R. Allan, International Harvester Co., 606 South Michigan avenue, Chicago.

Recommended Standards for Malleable Refractories

DOOR OPENING TILES

5x9x24 inches and 5x13½x24 inches

These thicknesses correspond with the standard 9-inch brick, the widths work out for varying wall thicknesses and the length will span any hole opening.

TAP-OUT BLOCKS

Outside dimensions 7½x7½x9 inches, with suitable flare from the hole to the face to allow room for the tapping rod and plugging up.

One block to have a ¾-inch diameter hole for foundries using hand ladles.

One block to have a 1-inch diameter hole for furnaces served with bull ladles.

SHAPES FOR BUNGS

Classification	Size in Inches
No. 101 square bung	13½x4½x3
No. 102 angle bung	(13½—12¼)x4½x3
No. 103 arch bung	13½x4½x(3—2⅝)
No. 104 arch angle bung	(13½—12¼)x4½x(3—2⅝)
No. 105 arch bung	13½x4½x(3—2⅞)

Some of the above bung shape dimensions have been changed from present sizes with classification number remaining unchanged.

SHAPES FOR SIDE WALLS, BRIDGE WALLS, ETC.

Classification	Size in Inches
9-inch straight	9x4½x2½
9-inch large straight	9x6¾x2½
	(for breaking joints)
9-inch soap	9x2½x2¼
9-inch split	9x4½x4¼
No. 1 arch	9x4½x(2½—2¼)
No. 2 arch	9x4½x(2½—1⅞)
No. 1 wedge	9x4½x(2½—1⅞)
No. 2 wedge	9x4½x(2½—1½)

SHAPES FOR STACKS

Circle Brick	Size in Inches
24 inch circle	9x4½x2½
36-inch circle	9x4½x2½
48-inch circle	9x4½x2½
60-inch circle	9x4½x2½
72-inch circle	9x4½x2½
84-inch circle	9x4½x2½
No. 1 wedge	9x4½x(2½—1⅞) and 9x4½x(2½—1½)

Spiral Test Bar Gages Fluidity

of Cast Iron and Nonferrous Metals

By C. Curry

ONE of the most interesting problems which regular foundry practice brings up, is the fluid quality of the metal. Since, the quality of the metal is one of the fundamental ones in foundry work, the search for practical means that will aid in reducing the percentage of scrap castings seems no less interesting.

Accordingly, the fluidity or running qualities (life) will be defined as follows: *The aptitude of a liquid in a given condition to fill a mold prepared under determined conditions.* This quality depends on a good many factors such as temperature, viscosity of liquid, nature of liquid, temperature of mold, weight, surface, superficial curvature of the castings, nature, dimensions and dispositions of the mold, conditions of surface, etc.

Knowledge of only one of these factors does not permit us by any means to determine the quality which we want to define. Thus, the temperature of an alloy is only an insufficient indication for the foundryman; iron coming from a cupola may have a high temperature and still possibly is not as liquid as another one having a lower temperature, but of a different chemical composition. Therefore, it is of the highest importance for the foundryman to possess a simple and speedy means of investigating, that will permit him to judge promptly on this point which is of greatest interest to him.

Conducts Tests

VARIOUS types of bars have been used to determine the fluidity of casting alloys. Although the spiral type of bar first was introduced several years ago, little investigation of its characteristics has been done. This article is abstracted from a paper presented in behalf of the Association Technique de Fonderie de France at the Chicago convention of the American Foundrymen's association. The author is located at Ardennes, France.

The Ecole Superieure de Fonderie, Paris, could not but feel interested in this problem, so this research was indicated to the students as likely to form the object of the personal work imposed on each of them, on account of its possibility of being treated scientifically. The result is the present experimental work, performed with the aid of suggestions given by E. Ronceray, manager of the study course of the Ecole Superieure de Fonderie and augmented by the result of the researches followed since then, which we intend to review in the following portions of this paper.

This problem, moreover, has for a long time constituted the object of intense work of eminent practical men. It seems that the first researches on the subject must be attributed to Thomas D. West, who, in 1898, made experiments as to running qualities by making up the test bar shown in Fig. 1. This test bar constitutes a first attempt, although insufficiently handled is still sufficiently interesting, especially if

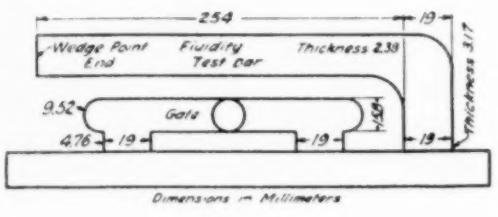


Fig. 1

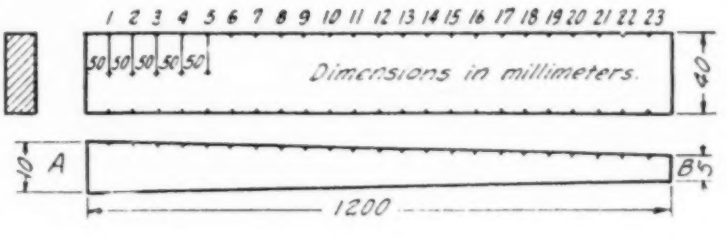


Fig. 3

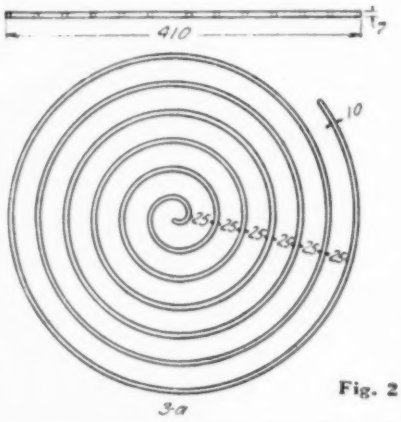
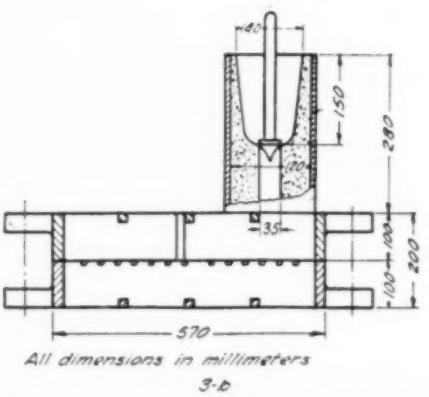


Fig. 2



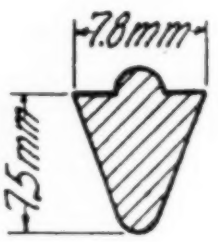


Fig. 4

FIG. 1—TEST BAR OF T. D. WEST. FIG. 2—SPIRAL BAR OF SAITO AND HAYASHI. FIG. 3—WEDGE SHAPED BAR OF THE BROUSSEVAL SHOPS. FIG. 4—SECTION OF MODIFIED SPIRAL SHAPE

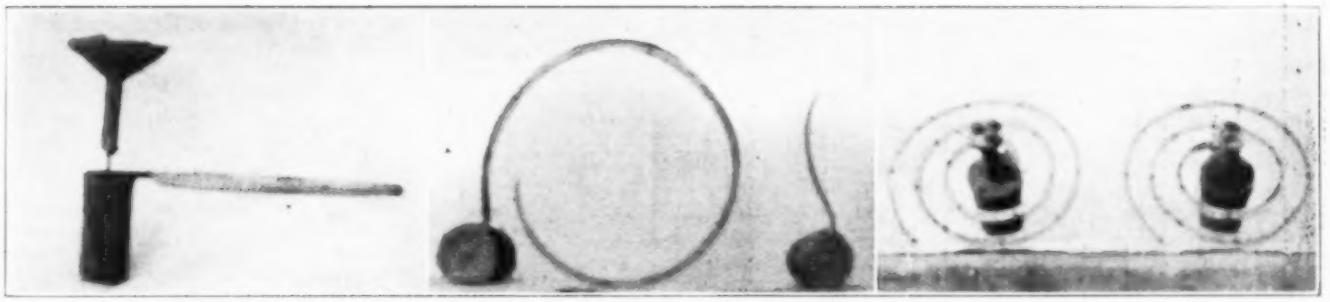


FIG. 5—SIDE VIEW OF SPRUE, RESERVOIR AND SPIRAL BAR. FIG. 6—SHORT SPIRAL CAUSED BY A LARGE FIN IN THE GATE
FIG. 7—FILTER CORES WITH TWO OR THREE HOLES GIVE SAME LENGTH OF SPIRAL

we consider the date when it was performed.

The question was studied after West by several persons, and there may be mentioned the test bar of Mr. Ledebut (1904); which test bar of 250x-25x1.5 millimeters (9.83x0.98x.059 inches) was run on one end similarly to West's test bars.

The experiments of A. H. Sexton and J. S. G. Primrose (1911) were made with a thin test bar of the same kind of section (1 inch by $\frac{1}{16}$-inch) run also on one end. In 1917 Dr. Richard Moldenke used a test bar in wedge shape, pointed at one end and of a section of 1 inch x 1½ inches at the other. It should also be noted that the shops of Brousseval presented to the first International Foundrymen's congress in 1923 a similar but long test bar which is run flat as may be noted in Fig. 3.

In 1919, two Japanese experimenters, Daikichi Saito and Kennosuke Hayashi, *Proceedings*, college of engineering, Kyoto Imperial university, II, 1919, and IV, 1924, originated a test bar of the following form:

"Instead of using a simple, straight rod as a pattern for making the mold, they used a spiral of the type shown in Fig. 2 respectively, to show up in a still more striking way the differences in fluidity between samples of different metals. The mold was provided with a pouring gate, and a riser at the center. The pattern was embedded in sand so as to make a mold into which the metal could run", C. H. Desch, *Foundry Trade Journal*, Feb. 2, 1922.

In 1922, Mr. Remy, malleable founder at Liege, Belgium, again took up this test bar, which he made in the following manner:

The spiral has a circular section of 6 millimeters, or 0.24 inches. The metal is poured in a basin placed on the side of the mold and runs into a reservoir located underneath where the cast iron runs down, through a hole of 5 millimeters (0.197 inches) diameter. The dimensions of the reservoir as shown in Fig. 8 are established in such a way that the metal penetrates into the spiral only after the filling of the inlet basin and consequently with a speed that is constant.

This test bar has seemed to embody the most rational conception that has been reached; hence we have started from this with the intention of examining more especially the influence of the mold itself and of its condi-

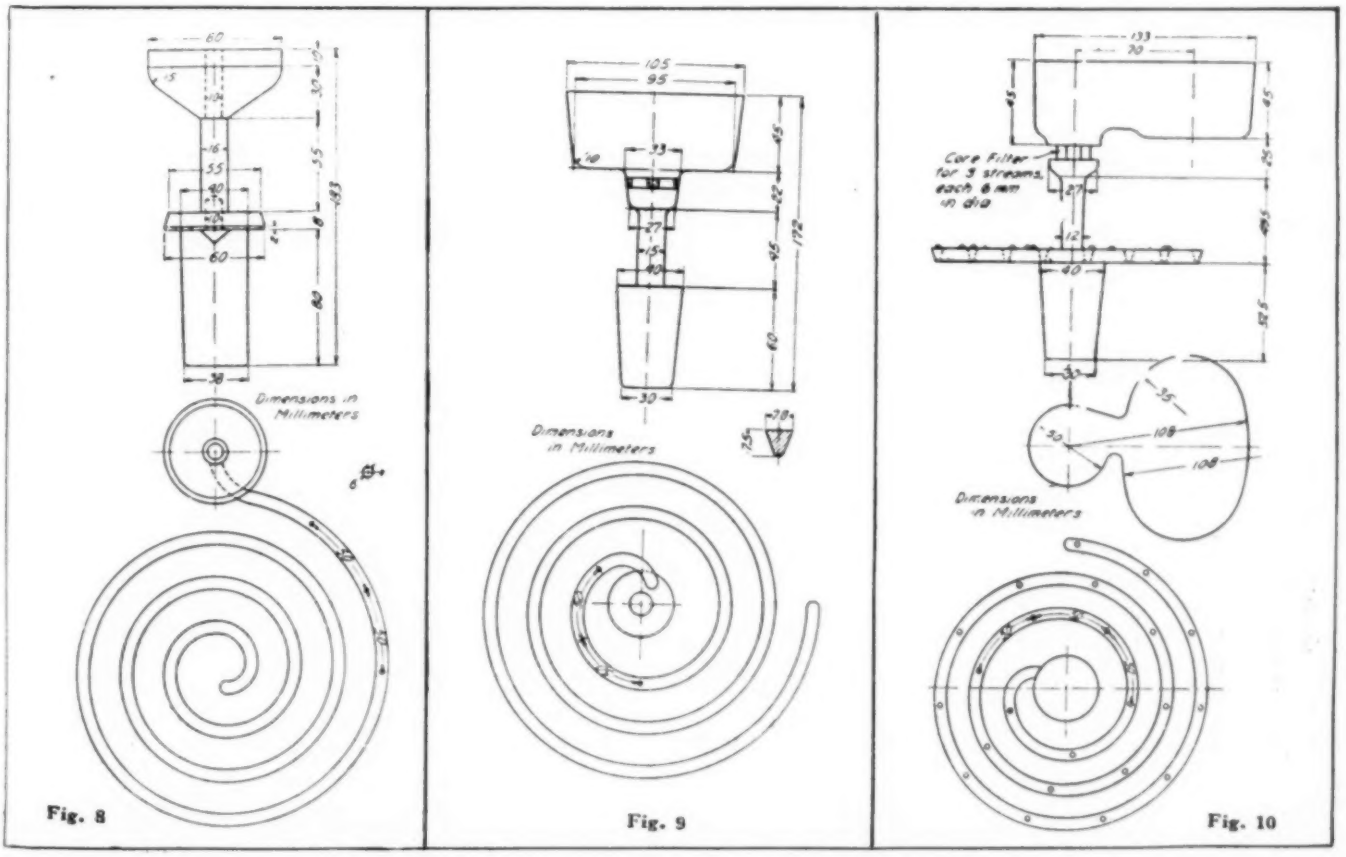


FIG. 8—TEST BAR OF REMY. FIG. 9—SHOWING CHANGES MADE IN BAR. FIG. 10—DIMENSIONS OF BAR AS USED AT PRESENT TIME. CHANGES FOLLOWED RESULTS OF PREVIOUS EXPERIMENTS

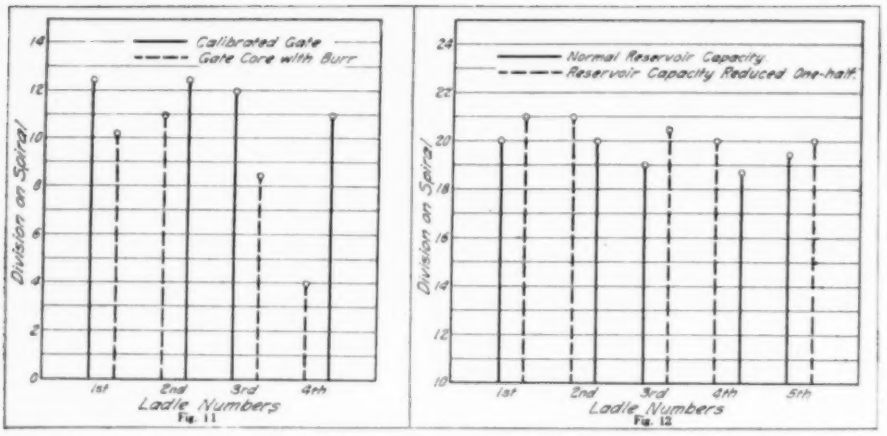


FIG. 11—RESULTS OF EXPERIMENTS WITH CALIBRATED GATE AND WITH FIN ON GATE CORE. FIG. 12—CHANGE IN RESERVOIR CAPACITY DOES NOT AFFECT RESULTS TO ANY GREAT EXTENT

tions on the various results obtained.

In accordance with Mr. Remy and on the suggestion of Mr. Ronceray it seemed useful to modify the section of the spirals which presented difficulties of molding, and to replace it by a section of triangular form with slight rounding at the parting. The dimensions given in Fig. 4 have been calculated in such a way that the new section is essentially equal to the old one to observe the same volume of delivery.

The first tests run on identical molds, which were rammed by a pressure molding machine, using the same sand and poured as green sand molds in a horizontal position, and poured from the same ladle of hot iron, have disclosed rather noticeable differences in the length of the test bars obtained, and accordingly we had to conclude that the test bar was imperfect.

Successfully eliminating the different factors which seemed to lead to errors in the results, we have been able to state that the least burr (fin) in the gate of the core, which gate has a diameter of only 5 millimeters (0.197 inches) and even a slight dropping of the sand from this core at the movement of casting, had the effect of considerably modifying the results. We have found that for a gate section reduced from 5 to 4 millimeters (0.197 to 0.157 inches) the difference in the lengths of test bars was of an order of four divisions. With a considerable burr reducing by about one-half the section of gate the spiral ran only two divisions, while the same metal run thereafter in a test bar with smooth-bored core reached 11 divisions as shown in Fig. 6. Fig. 11 reproduces the data obtained in the experiments. The irregular section of the gate of the core has a considerable influence on the result. We shall see later, how this cause of imperfection was eliminated.

In tests which followed, with a view to looking into the other factors, we made it a point that the tap hole was as exactly dimensioned as possible. Having thus made the experimenting conditions identical, we found the following points to exist:

Horizontal position of the mold

This factor is important, a slight incline falsifying entirely the results. In a general way we have noticed that the inclination of the mold was reducing the length of the spiral as presented in Fig. 13. This can readily be explained by the tendency which the metal has to drop to the lowest point and stay there.

Humidity of sand

This factor, to our great surprise, does not seemingly interfere at all, even if the humidity is greatly changed. We have run at the same time, molds in dry sand, whose moisture content did not exceed 3 per cent, and molds made with a sand with 7 per cent moisture, and have obtained in the two cases substantially the same results. We have gone further by drying a mold with a welding lamp and running it at the same time with another one in moist sand; the difference between the two test bars obtained would reach hardly one division as may be noted in Fig. 14.

Influence of the trapped air at the extremity of the spiral

We thought that the gases compressed at the end of the spiral at the moment of the run might oppose a certain resistance to the path of the metal. Experience has shown that this was not the case and that vent holes from 2 millimeters up to 10 millimeters (0.079 to 0.394 inches) and beyond did not influence the results in any way.

These points ascertained, permitted us then to turn our researches on two principal points as follows:

Remedying, if possible, the cause of error arising from the difficulty of exact dimensioning of the core.

Doing away with, or at least decreasing the influence of the inclination of the mold.

The solution of these problems, it seemed to us, were to be sought in

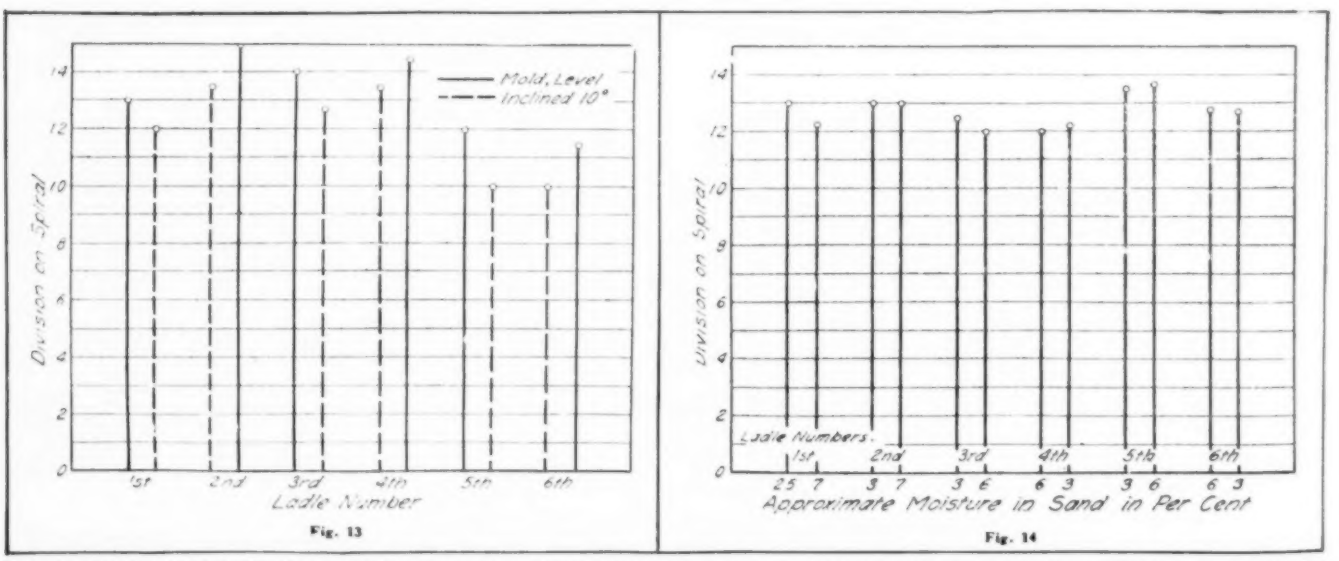


FIG. 13—INCLINATION OF MOLD CAUSES VARIATION IN RESULTS. FIG. 14—MOISTURE IN SAND HAS SLIGHT BEARING ON THE LENGTH OF SPIRAL FORMED

two ways. For the first point by looking into the way of regulating the speed of iron run through the section of the spiral and not through the section of the gate of the core, the latter having only the purpose to avoid the dynamic effect of the stream of metal. For the second point by placing the runner at the center of the mold.

For this purpose, and at the suggestion of Mr. Ronceray, we changed the test bar in the following manner: The gate is placed in the center of the spiral; the gate is provided with a filter core of a standard form with three filter holes of 8 millimeters (0.315 of an inch) diameter, and the downgate has a section of 15 millimeters (0.59 inches). The reservoir was reduced in part; it may be reduced still more, as we shall see later. Fig. 9 shows a sketch of the test bar thus changed.

When the results of larger capacity of the gates and filter holes were compared with more sensitive gates when placed under identical conditions, the results remained essentially constant. We have been able to note that starting from a certain limit, the increase of section of the holes of the strainer gate did not influence the results. This statement is based on experiments made with tests of filter cores with three holes and with two holes, for which we have obtained the same lengths. Fig. 7 shows two test bars run at the same time under such conditions.

On the other hand, the role of the reservoir which, in the foregoing test bar, was to obviate the running of iron into the spiral before the complete filling up of the basin, had in the present case only the purpose of receiving the first lot of iron. The experiments made with reservoirs of varying capacity clearly indicate that if the path of the metal increases slightly to the proportion in which the capacity of the reservoir increases, the results for one and the same approximate capacity remain constant, and we would say that it is possible to reduce without inconvenience the dimensions of this reservoir according to Fig. 12.

From the above experiment it may be concluded that the arrangements described permit the obtaining of results that can be compared without varying the factors foreign to the metal, except within limits practically easy to obtain. It is sufficient for this purpose to make a mold in green sand under conditions that are simple, and to run the iron through a core filter of standard design of three holes of 8 millimeters (0.315 inches). This eliminates to a considerable extent, the cause of errors arising from a defect of inexact dimensioning of the filter core holes of 5 millimeters (0.197 inches) and in the second place of obtaining with the same metal at the same temperature, the largest length of spiral and a scale of comparison that can be interpreted easily. Later it was found interesting to make a pouring basin avoiding the direct pour on the filter core. Fig. 10 shows the changed box and the apparatus as it is made up and employed at present.

Regular use of this test bar has permitted us to make unusually interesting observations. For instance, the linings of the mold play an important part on the facility of filling. It has been found that molds lined with graphite give a number of divisions much higher than a mold with natural sand, and this has avoided numerous rejections by continuing the use of the graphite, which was about to be discontinued.

In malleable iron foundries, the molders have arguments with the man in charge on the quality and temperature of the metal supplied. In our foundry we are running chiefly small pieces. The molders are working on a piece work basis. This test bar has become almost indispensable, not only to assure a good run of the pieces, but also to serve as arbitrator between the management and the workmen; this arbitrator permits us to establish without any error the cause of the scrapping. In the manufacture of a special article in great numbers, for instance, we were able to establish a scale of running

Results Obtained on Fluidity of Nonferrous Metals

	Cu	Sn	Ln	Pb	Ni	Al	Fe	Mn	Th	Si	Miscellaneous	Fluidity Qualities in Division
Copper	99.5	....	....	....	....	....	....	....	....	....	0.5	6*
	93.0	0.85	1.15	0.75	....	....	0.25	....	....	....	....	9†
	92.95	0.65	0.85	....	....	....	....	....	....	1.45	0.05	11‡
	93.0	....	1.50	....	1.42	....	....	....	....	....	0.08	11‡
Bronze—B¹	90.0	8.0	2.0	....	....	....	....	....	....	....	....	14
	90.0	7.5	1.0	1.5	0.05	....	0.25	....	....	....	0.20	18
Bronze B²	86.0	14.0	....	....	....	....	....	....	....	....	....	16
	85.0	13.0	1.22	0.08	0.20	....	0.10	....	....	....	0.40	21
Bronze—B³	86.0	12.0	1.88	....	0.04	....	....	....	0.03	....	....	18
Bronze—B⁴	77.0	8.0	....	15.0	....	....	....	....	....	....	....	14
	76.5	7.5	....	14.5	1.0	....	0.5	....	....	....	....	16
Marine—88.12	88.0	12.0	....	....	....	....	....	....	....	....	....	12
	86.16	10.96	1.35	1.42	Traces	....	0.03	....	....	....	0.08	17
Marine—90.10	90.0	10.0	....	....	....	....	....	....	....	....	....	10
	89.94	9.63	....	0.17	0.06	....	0.01	....	....	....	0.19	12
Brass—70.30	70.0	....	30.0	....	....	....	....	....	....	....	....	7
Brass—68.35	65.0	....	35.0	....	....	....	....	....	....	....	....	8
Brass—60.40	60.0	....	40.0	....	....	....	....	....	....	....	....	10
Brass—H.R.	58.2	38.8	....	....	0.5	....	1.0	1.5	....	....	....	12‖
	55.2	37.3	....	....	2.0	2.00	1.5	2.0	....	....	....	14‖
	55.2	36.8	....	....	4.2	....	0.2	2.8	....	....	0.8	18‖

*Metal completely oxidized.
†Metal sound, the spiral is carried back to the straight line, it breaks if the tests of malleability are continued; this is the indication of the presence of Sn and Zn.
‡If the running qualities have been increased, this fact is indicated by breaking of the test bar in hot condition; the pieces are malleable when in cold condition.
§Has not any increased running qualities nor malleability in increasing the assumed percentage of copper doing away with the effect of Zn.
‖These brasses H. R. run as cold as possible.

qualities, through which we almost have eliminated entirely the rejected castings. A ladle of about 40 kilograms (88.2 pounds) giving from 11 to 12 divisions to the test bar, permits us to run a series of molds without misruns. On the other hand, if the same ladle gives about 10 divisions, it is necessary to pig the 8 or 10 kilograms (17.6 or 22 pounds) from the bottom of the ladle to obviate the misrunning of the pieces contained in the last molds. Below 8 divisions it is useless to try to run the molds; they will not fill up.

Fluidity Test Applied

The test bar is also of great advantage for controlling the operation of the cupolas; running a test bar at any instant permits us to discover immediately any defective feature of the apparatus, whether it be through hanging up of the charges, through irregularity of charging, or oxidation.

In the case of foundry work entailing copper alloys, the test bar for running qualities possesses a field of investigation still more extended, because the test bar aside from the measuring of the degree of fluidity, gives an indication as to the chemical composition of the alloys poured.

The test bar used was changed slightly in the stopper rod in the basin and by increasing slightly the capacity of the basin, so that its contents are a little above the volume of metal necessary for filling the spiral and its gate.

Thus designed the test bar permitted us, to determine the composition of alloys cast, while investigating the running qualities of different typical alloys and by examining the influence of the alloying metals on the different mixtures.

The accompanying table, listing the data of experiments made by Mr. Thibault, shows the influence of the special elements on the running qualities. These results were obtained with alloys strictly graded, and by running four tests on each alloy.

Another especially interesting point consists in the examination of the best deoxidizer for copper which would be capable of increasing the poor running qualities of this metal, while at the same time improving its mechanical qualities.

Experiments were undertaken by employing successfully as deoxidizing agents, zinc, manganese, nickel, phosphorus, aluminum, manganese and silicon in running thin sections of copper.

All of these have increased the running qualities by three or four divisions, but it is found that the employment of silicon, magnesium and aluminum and even of zinc caused the test bars to break on taking them out. This defect was confirmed when running pieces under the same conditions. It would seem that the best deoxidizing agents to use would be manganese, phosphorus, and nickel. The latter, incorporated in the form of 50 per cent zinc-nickel gives the best results.

It also was noticed that with a sound and well deoxidized copper, it was possible to straighten the spiral of the test bar and to again roll it in spiral form in a contrary direction.

It readily can be seen how much information the bronze foundryman can derive from this test bar. While it informs him on the chemical composition of his metal, it also will permit him to learn quickly the composition of the scrap and to determine approximately the final composition.

Owing to the influence exercised by the variation of the ratios between copper and zinc in brass and its effect on the running qualities and malleability, the test bar also will supply to the foundryman several accurate observations.

Results on Other Metals

It has been found that the running qualities of brass, 65 copper to 35 zinc, hardly will exceed 8 divisions. With the same proportion of copper-zinc if the mark of 8 was exceeded, we always found incorporated in these brasses in small quantities such metals as aluminum, silicon, iron, etc. At the same time, while the running qualities increased, it was found that the malleability decreased. This is the kind of brass that exhibits high strength. In these alloys the ratio of copper to zinc is always approximately 60 to 40 and, it is especially in the examination of metals introduced such as aluminum, silicon, lead and iron that the test bar will be of considerable aid. In fact, some of these additions will, sometimes, reach 4 to 5 per cent and the great influence which they exercise on the assumed composition of the alloy is well known, so that it is interesting to know them and examine their effects.

In this way a high resistant brass, which possesses high strength with a small percentage of aluminum, has a running property that might reach 18 divisions, while the 60 to 40 ratio gives only 10. Above 14 divisions, the test bar is brittle.

Finally, a last application of the test bar applied to the nonferrous metals in the case of iron, is in the examination of the influence exercised by the linings of the mold. As an example, it has been found that a brass (65/35) giving 8 divisions to the test bar can be made to give as high as 12 divisions if care is taken to spray a naphtha residue or linseed oil on the mold.

Owing to lack of time, the tests related in this article could not be carried any further. However, this paper is presented, in the hope that the American foundrymen will look carefully into this plan of testing. Experiments will be continued to improve and perfect still further the test bar to determine the running qualities of cast metals.

Properties of Materials

Question: Frequently I find it necessary to calculate the amount of metal required to fill a mold and I experience considerable difficulty in arriving at a satisfactory result. Can you furnish me with a ready reference table of some kind that will enable me to do this work with a minimum of trouble. I understand how to find the cubical contents, but I do not know the figures which represent the weight of a cubical inch of the various metals used in the foundry.

Answer: Since you are familiar with the method for finding the cubical contents of the casting we shall not enter into that phase of the problem. The accompanying table will supply the additional information you require. The figures in the fifth column are included particularly to facilitate finding the amount of metal in the runners. The diameter squared multiplied by the constant shown opposite each metal will indicate the weight of each foot of runner.

Factors in Finding Casting Weights

	Specific gravity	Weight cubic foot in pounds	Weight cubic inch	Weight in feet round rod D x	Square plate 1 inch thick
Cast iron	7.218	450	0.2604	2.454	37.5
Steel	7.804	486.6	0.2833	2.670	40.8
Bronze	8.855	552	0.3195	3.011	46
Brass	8.393	523.2	0.3029	2.854	43.6
Monel metal	8.95	558	0.323	3.043	46.5
Lead	11.38	709	0.4106	3.870	59.1
Aluminum	2.67	166.5	0.0963	0.908	13.9

Traces Nonferrous Melting *In Electric Furnaces*

By H. W. Gillett

APPLICATION of the electric furnace to brass melting has been a development of the last 15 years. This period may be divided into three five-year periods; 1912-1917, experimentation; 1917-1922, commercialization; 1922-1927, standardization.

Dr. Roeber, former president of the American Electrochemical society, in 1905, discussed the advantages to be gained by electric melting. He also pointed out the importance to the central station of the potential brass furnace load. Dr. Parsons, as secretary of the American Chemical society, in 1912 arranged a symposium of that society on mineral wastes in which the probable value of the electric furnace in reducing zinc losses was brought out. As chief chemist of the bureau of mines, he inaugurated extensive experimental work in that bureau on electric brass melting. In the experimental period work was done by Messrs. Baily, Bennett, Hering, Northrup and Wyatt, furnace designers; by Messrs. Bassett, Clamer and Webster, executives in the brass industry; by Messrs. Crosby and St. John, of central stations, and by Messrs. Lohr, Mack, Rhoads and the author in the bureau of mines.

From the pioneer work of the experimental period it became plain that the types of electric furnace used for steel melting were not applicable to brass, and that special types would have to be developed. Four important special types resulted, the reflected heat type (Baily) the vertical ring induction (Ajax-Wyatt), the high frequency induction (Ajax-Northrup) and the rocking arc (Detroit). Variants of these types then began to appear.

The variant of the reflected heat type, the General Electric contact-arc resistance furnace, appeared and disappeared, one of the vertical ring induction type, also a General Electric product, similar to the Ajax-Wyatt, was put out, but this too, no longer is regularly sold; and a rotating arc, the Booth, followed the Detroit. The moving arc furnace idea was still later utilized in the Volta (Canada), the Watson (England), the Russ, the Rheinmetall Rollofen, and the Demag "Elektro-ofen mit Schaukelbewegung" (Germany). Variants of the high-frequency type have appeared in France, and others are now in development in this country.

Meanwhile the direct arc type, like the Snyder, and the stationary indirect arc type, like the Rennerfelt and Re-pel-arc, and the Hering pinch-effect type as well as the Bennet contact resistance type were thoroughly tried out in practice.

Though direct and indirect arc furnaces, such as serve for melting steel, are in general use on nickel alloys, today none appear to be in regular use in the United States on copper alloys. The Hering was soon superseded by the Ajax-Wyatt. The reflected heat type reached its zenith around 1920 and has been falling into disuse since. Probably not over 15 of these furnaces remain in active service out of some 90 that were installed in the United States. Nevertheless, over half of the firms that used them still are using some type of electric furnace.

Baily's pioneer work should receive due credit for helping to bring home to the industry the fact that an electric furnace would work and would reduce metal losses. While the thermal efficiency of the Baily furnace was too low to keep it generally in service in competition with more efficient types, the development and commercial introduction of the furnace was no small factor in bringing about the present status of electric melting.

There appear to be in active service approximately 10 Booth furnaces out of 35 or 40 that have been installed. One Bennett furnace is believed still to be in use. Various other types and makes have been tried and almost wholly discarded. Altogether there have been at least 175 furnaces installed which have done commercial melting, some of them for extended periods, which are not now in active use, though many are held as spares.

Experience with these obsolete or idle furnaces has been of value in developing knowledge of proper principles of design and use. Counting experimental furnaces, the idle and spare furnaces just mentioned, the active furnaces in this country and those sold abroad, over 1,000 electric brass furnaces have been built in the United States. While experience is limited in years, its total in furnace-years is large.

Although at least 100 fairly distinct furnace types have been suggested, at least 50 have been tried, more or less extensively and perhaps a dozen have been in real commercial service, it was obvious at the beginning of the standardiaztion period that the field was being divided among two types, the vertical ring induction, and the rocking arc, with the possibility that the high-frequency type would sooner or later be of commercial importance.

The situation remained the same at the middle of the standardization

Melt Electrically

GREAT progress has been made in the design and perfection of equipment for melting nonferrous metals electrically during the past 15 years. Although a number of the types of furnaces, which have been installed in the United States and Canada, have been found unsatisfactory, either from the standpoint of economy in operation or quality of product of metal melted, the information gathered from the operation of these furnaces has been of great value in reaching the state of perfection found in the leading types of units employed today. Development in the field of electric melting of nonferrous metals is traced in this article, which is abstracted from a paper presented at the Philadelphia meeting of the American Electrochemical society, last spring. The author is chief, division of metallurgy, bureau of standards, Washington.

period, and remains the same today, save that the tendency in respect to the Ajax-Northrup is toward the use of a somewhat lower, that is, medium, frequency, generally 480 or 960 cycles at around 2,000 volts, which is better fitted for commercial service than the high frequencies and voltages required in the smaller furnaces used for laboratory work and small scale melting.

With the passage of time and the accumulation of experience, the industry automatically has brought about a high degree of standardization by a natural process of elimination. The allocation of the three important types of furnace to specific tasks in rolling mills and foundries, is also a matter in which there has been some automatic standardization. The use of the vertical ring induction furnace is almost exclusively confined to continuous (24-hour) or at least two-shift operation, and to alloys of not over 90 per cent copper.

These conditions obtain in rolling mills, but do not obtain in foundries. This type is therefore primarily a rolling-mill furnace. The rocking arc furnace is applicable to the conditions obtaining in foundries, and can handle alloys of any composition.

The nickel-brasses, often called nickel-silver or German silver, alloys which are really brasses containing up to 20 per cent nickel, are not handled satisfactorily in direct arc or stationary indirect arc furnaces, which are used on zinc-free nickel alloys, because of loss of zinc. Their melting points are so high that the refractory life of the vertical ring induction furnace is not satisfactory. The American Brass Co. has satisfactorily operated 14 medium frequency induction Ajax-Northrup furnaces on nickel brasses for over a year, and controls exclusive rights to the use of this type of furnace in the wrought brass industry. Nickel brass also is melted in rocking arc furnaces in both rolling mills and foundries.

Electric Brass Melting

The extent to which electric melting is being done in the brass industry may be seen by considering the table accompanying, which includes only active furnaces, and excludes those that are installed, but idle, or those (estimated as about one in six), held as spares in batteries of furnaces in the rollings mills. The estimated actual production corresponds with capacity operation for only about 210 working days to allow for periods of reduced activity.

Figures given in the accompanying table involve various assumptions, and it would be of interest to check them up by giving in detail the calculations upon which they are based were space available. The estimates for the electric melt are based on more dependable data than those for the fuel-fired melt.

To approximate the total melt, census figures for 1923, the latest available; correction factors obtained from the industry as to relative production in 1923 and 1926; the 1926 copper and zinc production figures, with the ratio of these metals normally used for brass and bronze to total production; estimates from the industry as to ratio of melt to finished product in rolling mills and foundries; the data of the joint committee on refractories of the American Foundrymen's association; such data as could be obtained on electrode consumption and tonnage of electrodes used, figured back to tons of melt; and various estimates, guesses and actual data from furnace makers and users, have all been brought to bear. The off-hand guesses run from much below to much above the figures taken. Most of the calculations based on apparently reliable figures and assumptions check fairly well, but the assembing of fully dependable estimates of total melt is an extraordinarily difficult task.

From the various methods of calculation it seems probable that a 1926 melt of 500,000 tons for the rolling mills and 800,000 for foundries, a total of 1,300,000 tons, with 450,000 and 225,000, a total of 675,000 as the electric melt, will serve as reasonable estimates. It should be remembered that these figures are for the melt, not the finished product. If anyone considers these estimates too favorable to electric melting, he can use his own. Even if they are too high today, it will take but a short time, at the present rate of progress, before they do represent conditions to a sufficient degree of correctness.

The estimates indicate that if all the furnaces in foundries had been

Electric Brass and Bronze Furnaces

In Active Use in United States and Canada—Feb. 1, 1927

Excludes idle or spare furnaces. Includes those melting copper, nickel brass and aluminum bronze. Other nickel alloys, aluminum, lead, type metal, precious metals, etc., are not included

FURNACE	No. Firms	No. Furnaces	Kilowatts Connected	Capacity Kw.-hr. per year	Capacity Tons of melt per year		Estimate actual melt in 1926, tons (j)
Wrought Brass Industry							
Ajax-Wyatt (271); Gen. Electric (8)	19	279	17,700	92,040,000(a)	383,500(b)		305,000
Detroit	10	28	8,000	41,600,000(a)	154,000(c)		125,000
Ajax-Northrup	1	14	1,400	7,280,000(a)	22,400(d)		20,000
Total, wrought brass industry	24(e)	321	27,100	140,920,000	559,900		450,000(k)
						Fuel	50,000
						Total	500,000
Brass Foundry Industry							
Detroit	122	231	33,500	69,700,000(f)	232,300(g)		185,000
Ajax-Wyatt (40); Gen. Electric (2)	18	42	2,700	11,200,000(h)	34,500(g)		27,000
Others: Booth, Baily, Volta, Re-pel-arc, Bennett	20	30	3,000	6,200,000(f)	17,700(i)		13,000
Total, foundries	151(e)	303	39,200	87,100,000	281,500		225,000(l)
						Fuel	575,000
Total, brass mills and foundries	175	624	66,300	228,020,000	841,400	Total	800,000
						Electric	675,000(m)
						Fuel	625,000
						Total	1,300,000

a. Calculated on basis of full power on 20 hr. per day, 260 days per year.
b. Calculated on basis of 240 kw.-hr. per ton of yellow brass. See Iron and Steel Eng., 3, 225 (1926).
c. Calculated on basis of 240 kw.-hr. per ton of yellow brass, 300 kw.-hr. per ton on other alloys, 270 kw.-hr. average for all alloys.
d. Calculated on basis of 325 kw.-hr. per ton of nickel silver.
e. Excluding duplicates.
f. Calculated on basis of full power on 8 hr. 260 days per year.
g. Calculated on basis of 300 kw.-hr. per ton.
h. Calculated on basis of full power on 14 hr. reduced power on 8 hr. or averaging full power on 16 hr.
i. Calculated on basis of 350 kw.-hr. per ton.
j. Taken as 80 per cent of the capacity as above figured, and rounded off.
k. Estimated kw.-hr. actually used, corresponding to this figure, 113,000,000.
l. Estimated kw.-hr. actually used, corresponding to this figure, 67,500,000.
m. Estimated kw.-hr. actually used, corresponding to this figure, 180,500,000.

put on steady 24-hour operation, and, if they, and all those in rolling mills, had been used 300 days a year, the whole 1926 melt of brass, bronze and nickel brass could have been made readily in the electric furnaces now installed.

The actual brass rolling mill output for 1926 seems to have been not far from 90 per cent, the foundry output almost 30 per cent, and the total output a little over 50 per cent electric.

It is interesting to note that each of the two chief types of furnaces the active installations of rocking produces about the same annual tonnage in the whole industry, while arc furnaces have twice the connected load of the vertical ring induction furnaces. This is due to the fact that the former operate chiefly in foundries on daylight melting and the latter in rolling mills on the 24-hour operation. It is also of interest that the estimated actual electric melt in rolling mills figures out to twice that in foundries.

Were space available for a detailed comparison of electric brass melting with electric steel melting, it would show that there are 125 more active electric furnaces melting brass than are melting steel in the United States; that while wrought brass is 90 per cent electrically melted, electric steel ingot production reaches 90 per cent only in tool steel. Only some 15 per cent of the alloy steel ingot production is electric, and alloy steel is itself only 3 to 5 per cent of the total steel production.

Practically no plain carbon steel ingots are produced by electric melting, the electric melt of carbon steel being for castings. Steel castings are made from electric steel to the extent of about 22 per cent, a smaller proportion than is found for brass castings. In size and in total connected load and kilowatt hour consumption the electric steel furnaces surpass electric brass furnaces, but if the two industries as a whole are compared, it is plain that electric melting has made greater headway in the brass industry than in the steel industry.

Effect on Industry

Assuming the table as reasonably accurate, we may figure out some of the effects upon industry from the use of electric brass furnaces.

At an average of 1.5 cents per kilowatt hour in the wrought brass industry, and 2 cents per kilowatt hour in the foundry industry, about $3,000,000 worth of electric energy was used by brass furnaces in 1926. The energy used in the United States for electric brass melting in 1926 amounted to nearly half the quantity generated and sold from the Wilson dam at Muscle Shoals in that year. More than $4,000,000 is invested in electric brass furnaces. The electric furnaces show a net melting loss at least 2 per cent lower than that of the fuel-fired furnaces they replace. Some 13,500 tons of metal, worth around $200 a ton thus is conserved, the saving being worth over $2,500,000 a year.

From the point of view of conservation of natural resources, the electric furnaces draw over 40,000 tons less fuel from our fuel reserves and 13,500 tons less metal from our metal reserves than did the fuel-fired furnaces.

Rather large blocks of power are taken by some of the chief users of electric brass furnaces. Thirty-two firms each have an active connected furnace load of over 400 kilowatts. Of these, one has nearly 10,000 kilowatts, three have between 3,500 and 4,500, eleven from 1,000 to 2,000, and seventeen from 400 to 900.

Melting Costs

It is interesting to speculate on the prospects for further electrification of brass melting. Obviously it was easier to introduce the electric furnace into the rolling mill industry as a whole than into the foundries. There are not much over 3 mills with production large enough to affect the statistics of the industry so the sales problem was simple, especially as the rolling mills had a good idea of their melting costs.

In the sand-casting foundry industry of the United States, with about 3,500 plants melting more or less brass and bronze, of which many have a small output, and relatively few of which really know their melting costs, the campaign of education is much harder to put across than it was in the rolling mill industry.

Sand molding is in general a daylight operation so the furnaces seldom run more than one shift. Melting efficiency is lower, the furnaces have a lower load factor and do not earn so low an energy rate, and interest and depreciation charges are higher per ton of melt than would be the case in continuous operation. Many of the smaller plants are located in small towns served by small central stations with high industrial power rates. Inter-connection of stations may in time partially remedy this.

Many plants do not have sufficient output to keep even the smallest available furnace busy. One central station figures that a melt of 2500 pounds a working day, or, say, 325 tons per year, is necessary before a brass foundry becomes a prospect for electric melting. Other authorities believe that 1500 pounds per day, or 200 tons per year, will pay for the investment in two years, and put the usual limit of usefulness at 1000 pounds per day, 125 tons per year. No figures are available as to how many plants come above this minimum, nor what proportion of the total melt such plants may produce.

Small Funace Pays

It is proving decidedly more economical to use a small furnace and keep it busy than to use a larger furnace than the production requires, and have it working only part of the time. The adverse effect upon melting costs of delays which keep a furnace idle are becoming better understood, as are the advantages of a high rate of power input. The fact that a large furnace driven only at a moderate rate, is not as effective as a smaller one driven at a high rate is now pretty well grasped by the user.

Nearly all of the furnaces installed in foundries in the last two years have been in the small sizes, and the rate at which they are being installed indicates that a saturation point for small furnaces in brass foundries has not yet been reached.

Central stations are, of course, interested in large loads in one plant and in the installation of furnaces, each of which takes a large connected load. However, they are interested even more in a number of small furnaces in different plants whose total load would equal that of the larger single plant, because the diversity factor is better, since the peak loads are better distributed.

Complete Standards for Pipe Flanges

Under the joint sponsorship of the American Society of Mechanical Engineers, the Heating and Piping Contractors' National association, and the Manufacturers' Standardization Society of the Valve and Fittings Industry, the American Engineering Standards committee recently has completed the first of a series of standards for pipe fittings and flanges.

In 1926, fluorspar shipped from mines in Colorado, Illinois, Kentucky and New Mexico amounted to 128,657 tons. The steel industry used 82.09 per cent and the foundry industry 4.83 per cent.

How and Why in Brass Founding

By Charles Vickers

Desires To Melt Scrap

We have on hand a supply of copper wire and brass borings of tin and lead alloy. What formula would you recommend for bushings using the above metals and melting in 2500-pound heats in a gas-fired furnace? Also at what stage of the smelting would additional tin and lead require to be added to the melt?

As the service demanded of bushings is so diversified it is merely guesswork to present a formula for a bronze for bushings in the absence of specific knowledge as to the use that is going to be made of the castings. The following formulas, therefore, are not given with the assurance they will be entirely satisfactory; (1) Copper, 86 per cent; phosphor-copper (15% phosphorus), 1.00 per cent; tin, 8 per cent; lead, 5 per cent. This alloy has been found satisfactory for friction bushes, such as used for lifting heavy board drop hammers. (2) Copper, 79.50 per cent; phosphor-copper, 0.50 per cent; tin, 10 per cent; lead, 10 per cent. This is suitable for bearings subjected to hard service; (3) Copper, 77.00 per cent; tin, 8 per cent; lead, 15.00 per cent. Usually about 4 ounces of phosphor-copper is added per hundred pounds of alloy, as a *"deoxidizer."* This alloy is useful for smaller bushings.

To use the scrap brass, whether borings or massive, some knowledge of its composition is necessary, the proposition being the same as mixing iron by analysis. In the case of massive brass scrap the only way in which a representative analysis could be obtained is by melting it into ingots, drilling every heat and mixing. However, this is too costly, therefore, some guessing has to be indulged in. Use about 25 per cent of such scrap; aluminum bronze can be detected by heating a piece of scrap red, then hammering to break which it will not do unless it's a copper tin alloy or a red brass. Manganese bronze can be detected by grinding and crowding the sample to heat it, when it will turn greenish. The only thing to do with such material is to sell it. The copper wire should to be pounded into a *cabbage*. The borings can be mixed and analyzed, then figured as part of the charge. The iron should be removed by magnets though, otherwise it may be found in the castings as hard nodules, as black-skinned castings with unnecessary "shrinks" here and there, or it may oxidize as it does at the blacksmith's forge, and produce anything from specks of dross to sponginess with plenty dross.

Be sure to remove the iron from the borings as when used with oxidized copper wire, they will be most likely to do their worst when generously peppered with iron. Melt the copper and the borings together. Be careful not to charge the borings in thin layers as slag. Melt quickly giving the least possible time for oxidation, and when thoroughly liquid add any tin and lead required to bring the metal to formula. A good brass flux is handy when melting scrap; note the advertising pages of THE FOUNDRY. Get the metal hot in the furnace, and cool to suit in the ladle at mold side. Phosphor-copper is added easiest in the ladle.

Does Not Cast Well

We are making brass castings of irregular shape and with heavy and light parts and have had difficulty running them with sharp corners and edges and in making them clean enough to take a bright nickel polish. The casting is a grip handle about 8 inches long with a ¼-inch cross section and irregular in shape, necessitating a match-plate mold. Could you suggest a metal mixture that will run this sharp and clean? We have tried formulas with aluminum additions but have not found one that is satisfactory. Perhaps we are pouring them too hot, or not hot enough and will appreciate any suggestions you may offer.

While yellow brass is a low cost alloy it is more difficult to handle in the foundry than composition—the red brasses, or the so-called half yellow, half red alloys. Due to this greater difficulty it by no means infrequently happens the loss with the yellow alloy makes it more expensive to use in the case of certain shapes than a red brass would be, as the lower metal cost is offset by the production losses.

When castings have heavy and light sections joined together and are also intricate, it is difficult to prevent shrinkage at certain points when a yellow brass with aluminum is used. Even minus the aluminum and with lower zinc to get a good casting yellow brass, shrinkages and draws can be expected more than with red metal. Therefore, it may be a good idea to get away from yellow brass for these castings and possibly the following formula would give better results: Copper 79 per cent; zinc, 12 per cent; lead, 7 per cent; tin, 2 per cent.

If strength is a consideration the following is a stronger alloy and also casts well: Copper, 84.50 per cent; zinc, 10 per cent; lead, 3 per cent; tin, 2.5 per cent.

Adds Zinc to Copper

We are making castings of copper weighing from 75 to 100 pounds each. When we pour the molds the copper swells out of the gates the same as blowing. We use pure ingot copper and add about one per cent phosphorus. Could you advise us what to put in to prevent this? We put a coating of silica sand on the face of the molds, then dry them. We want this sand to burn onto the face of the castings, and this is successful. Would a certain amount of zinc or tin overcome the rising of the gates?

The addition of 3 pounds of zinc to the hundred pounds of copper will prevent the latter rising out of the gates, but if an alloy of equal parts by weight of copper and zinc is first made, about 4 pounds of this alloy per hundred pounds of copper will give sound castings because the zinc is not lost by burning away as it is added. Sometimes about one per cent of tin is added as the copper then flows more smoothly, so that with 4 pounds of the 50-50 alloy and one pound of tin will give a nice smooth *copper* casting. For practically all intent and purpose the casting is copper in everything including appearance.

This is the old-fashioned method of making copper castings, and works perfectly in the case of castings not wanted of high electrical conductivity. However the phosphorus addition as now used gives sharpness to the fluid copper and aids in burning on the sand. By pouring the copper hot, it is possible that with the zinc and tin additions, the silica sand would be burnt on the face as wanted, if not it will be necessary to also add some phosphorus, in which case no doubt less zinc than mentioned above could be used and sound castings result.

Bill Traces the History of a Brass Casting

By Pat Dwyer

ONE of the oldest conundrums I remember is the famous: Which came first the hen or the egg? Usually it is asked merely as a catch question, because the average person is of the opinion it cannot be answered satisfactorily or convincingly. I have heard many interesting debates on the subject, but until recently I heard no argument to settle the question one way or the other.

I would not have you gather the impression that I have lost any sleep worrying over the subject. My appetite has remained normal and I did not develop a heavy vertical furrow in the placid brow. Occasionally I have read statistical reports showing how many millions of eggs are produced per year and per capita. Now and again, I have speculated idly on the probable difference between eggs, fresh eggs and strictly fresh laid country eggs.

In my ignorance I always assumed that nearly all eggs are laid in the country where conditions are favorable for an industry of that kind. However, I have known of instances, particularly in small towns, where an enterprising citizen kept a hen or two and I see no reason why any invidious comparison should be drawn, even by inference, between eggs laid in a backyard and those that first see the light of day in the great open spaces where hens presumably are hens and lay eggs with the precision and regularity of so many mechanical devices.

If I were in the egg business, or if I kept a hen or two, which I certainly have no inclination or intention of doing, I might be tempted to probe the subject more thoroughly. Under present conditions I am not interested. I do not know positively, or particularly care, whether eggs come from the city or the country, from a hen or from a steam shovel. The only eggs I see come from the grocery store at the corner and it is a matter of supreme indifference to me whether the foxy groceryman gets them from a farmer or a bootlegger. Judging by the price he charges I am inclined to the opinion that most of them are contraband.

However, the foregoing is beside the point at issue. What I had in mind when I started to write was that recently I saw a solution of the old problem: Which came first, the hen or the egg? Like the solution of nearly any problem, it is simple and logical and like any other similar instance I wonder now why I did not think of it before.

Ladies and gentlemen, the egg came first. How come? Sez you, or words to that general effect. Nothing could be more simple, I reply nonchalantly as if I had known about it all the time. In fact by slightly elevating one shoulder and injecting a slight hint of weariness into the voice I convey the impression that you must have been asleep at the switch all these years not to have discovered the answer for yourselves.

Secure in my knowledge, I might rest on the simple statement that the egg came first and defy you to prove that I am wrong. That is the method usually adopted in courts of law and a method which presents certain advantages where the party of the first part is supporting the doctrine—*what we have we hold.* In the present instance that factor does not hold. I have no intention of carrying the secret to the grave and, besides, I found the information in a paper which has a circulation of several hundred thousand.

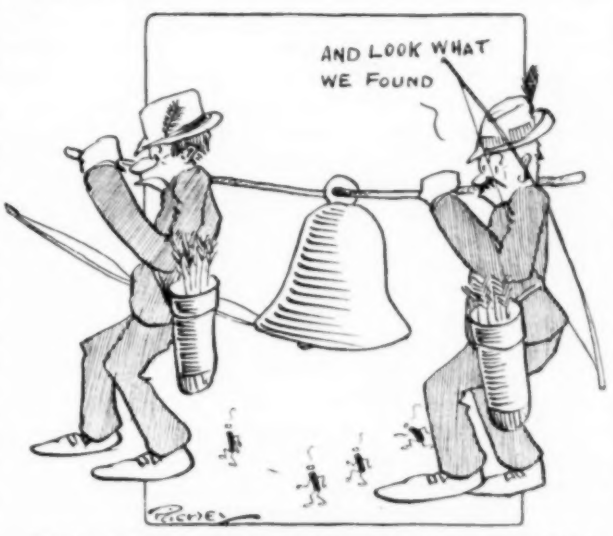
I am not optimist enough to believe that every one of these hundreds of thousands of subscribers read the item, but then on the other hand as you might say, it is extremely unlikely that I am the only person who read it. For the benefit of those who missed it and for others outside the field illuminated by the aforesaid great family journal I am passing the information along free gratis for nothing.

The egg contains the germ of life, therefore it always was and always will be. The hen merely is an incidental agent, but no more necessary than the nest in which the egg is laid. Hens and nests come and go but the egg continues forever. The first egg contained the life germ which later developed into a chicken and afterward a hen. All the hens died in turn after serving for brief periods as egg custodians. In a crude way a string of beads may be taken as an illustration. The beads correspond to the hens spaced either at regular or irregular intervals. The egg in this case is the string—a continuous entity without a break from beginning to end.

When Bill dropped in the other night to enjoy a quiet draft of the weed I brought up the subject casually by asking him which came first, the hen or the egg.

"Search me" said Bill. "I was not present when the procession started. My own private opinion is that eggs either grow on trees or are dug out of the ground like potatoes or peanuts. Crediting them to a hen is about as sensible as basing vital statistics on the number of storks in the zoo.

"Many years ago when I believed everything I read, I received a circular imploring me to go into the poultry business where a fortune easily might be amassed in selling eggs. I bought a flock of a



WHEN JOHNNY COMES MARCHING HOME, HURRAH!

dozen birds, built a coop and a runway, put the children on short rations so that I might pour a constant stream of high priced food into the hungry gullets of the flock of cormorants. I kept them for six months and never got an egg. Then I put the axe to them and we lived high for a couple of weeks. I sent the heads and feet back to the poultry man and hinted delicately that apparently he was out of spare parts and accessories.

"However" he continued "what about this hen and egg thing? I have heard the question often enough, but I always figured it was in the same class as 'How old is Anne,' 'How long is a piece of string' and 'Who struck Billy Patterson?'"

I explained that this had been a common belief for many years, but that through intense application, examination of musty records and burning of many gallons of midnight oil, I finally had discovered the solution. Then I outlined the chain of reasoning, the cold, pitiless logic which proved beyond the shadow of a doubt that the egg had come first.

"Well" said Bill "I'll tell you. I don't believe a word of the midnight oil and the rest of the bunk. You probably pinched the dope as usual from some place, or you heard some person talking about it, but even at that the theory is ingenious. Following the same line of reasoning, has it ever occurred to you that the brass in some castings may be traced back in a continuous line to the beginning of the Bronze Age?"

"Well, no" I replied "I never looked at the subject in that light, but now that you mention it, I can see some faint trace of plausibility."

"Faint trace of plausibility, indeed!" Bill remarked "Say, young fellow-me-lad, if you had a faint trace of imagination you could trace the history of a brass casting as easily as you can follow your own life back to the days you wore a pinafore and little else. In fact, more easily, because hundreds of incidents in your early life have been completely forgotten by this time. If the salvation of your immortal soul depended on the accuracy of your memory you could not tell me now if your first pair of shoes were laced or buttoned."

"What has the first pair of shoes to do with brass castings?" I asked him. "I wish you would stick to one thing. If the information will do you any good, or if it will help you to keep your mind in one track I can tell you the approximate date on which I received the first pair of shoes with copper bands on the toes. I can remember as clearly as if it was yesterday—"

"Yes, yes" Bill interrupted "I know all about 'em. I have worn the same little monstrosities. Had to pull 'em off at night with a bootjack. If I happened to get 'em wet they dried as hard as cast iron and the combined efforts of the entire family were required to remove them from the tortured little feet. I got the fright of my young life one night when my father, who was a little hasty in his ways, threatened to cut 'em off with the family axe.

THE STOUT FELLAH DOES HIS STUFF

"However, as you say, that has nothing to do with brass castings. Although to be strictly accurate, the copper bands probably were bronze or brass and thus quite properly might have had as interesting a history as the brass casting I had in mind in the first place.

"Of course I am not referring to a casting made from virgin metal although an interesting story might be written of its progress from the time the zinc ore is shoveled out of a Missouri mine and the copper ore is lifted from the bowels of the earth in Michigan to the time the two metals are melted in a pot and poured into a mold in an Ohio foundry by a husky guy from the region of the Danube river who does not know or care whether Michigan and Missouri are towns, Indian topknots or something to eat.

"No, my lad. I am talking about the ordinary or garden variety of brass casting, made from ingot metal, scrap metal, gleanings from the junk yard or what have you. If it was possible to trace the genealogy of some of these castings, the pedigree would extend back through a myriad of ramifications to the modest establishment conducted by Tubal Cain & Son, Inc., or to that of his successor the Hiram of Tyre Corp. purveyors of brass and bronze castings by special warrant to his Most Gracious Majesty, King Solomon I. God save the King!

"Instead of attempting to follow the history of a casting backward, let us reverse the process and trace the progress of a casting from the beginning up to the present. Naturally, it will change its shape many times and it will merge its identity with others in its many incarnations, but like the egg you were talking about a few minutes ago it will continue marching along like John Brown's body and show up strong at the finish.

"For a concrete example take one of the bronze castings made for Solomon's temple. After the Roman legions sacked and ravished Jerusalem they bore it away with other spoils of war either on dusty camel trains through Asia Minor and Greece, or shipped it by galley from one of the Mediterranean ports to the imperial city sitting proudly on its seven hills. Great triremes with their high carved beaks, triple rows of oars, loaded with soldiers, slaves and plunder were moored to the quays along the Tiber for discharge. By fours, column formation, heads up, eyes front, quick march, the soldiers swung up the main street to the Coliseum and stood at attention with a tough old campaigner's tongue stuck in each cheek while Nero or some other pompous bird read a long tiresome address expressing the nation's gratitude. Then, they were discharged to find that all the good jobs had been picked up by the boys who had stayed at home.

"Slaves were auctioned off to the highest bidders and the metal merchants trucked the bronze away to their warehouses. In the course of time our column was remelted and cast into a statue of Diana which graced one of the public squares for several hundred years. Then Attila, the Scourge of God, with his little playmates the Goths and Vandals came down from the North, sweeping a path with fire and sword from the North sea to the Mediterranean. What they did to Rome was a shame, but I imagine it elicted three hearty

and spontaneous cheers from descendants of those who had been rendered homeless by the legions and of others whose blood and tears had been spilled centuries before in the hilly, narrow and crooked streets of Jerusalem.

"Attila's commissary department smashed the statue of Diana and dragged it as far as central Europe on the return journey. Here they dropped it in favor of other plunder more to their fancy and here it remained until Charlemagne gathered it in with nearly everything else that was portable and carried it into France. French artizans melted it down and cast it into a bell.

"The tone of this bell was so sweet and sonorous that it captivated the fancy of a band of English soldiers engaged years later in their professional duty of wrecking a French city. At great personal sacrifice and trouble they carried the bell home to England and hung it in the parish church where it was run in thanksgiving for their safe return from foreign parts.

"The whirligig of time rolled along. Elizabeth came to the throne. Differences of opinion left many bells without steeples. England gradually was gaining supremacy on the seas and the gun shops were doing a great business in brass cannon. Our bell met the fate of others and was converted into a shining weapon of destruction.

"Lord Howard used it in a brief engagement with the Spanish armada before the job was taken out of his hands and the great galleons were swept away by a storm to be smashed against the coast of Ireland, Scotland and the bitter rocks of the Hebrides. The expedition practically knocked Spain out of the big league.

"The gun accompanied Drake in his voyage around the world and it formed part of the armament of Morgan when he burned Panama and Cartegena. For years hairy old sea dogs in pig tails, jack boots and ear rings polished it with care and directed it with rare taste and skill against the enemy, any enemy, as they prowled over the length and breadth of the Spanish Main. When the ship would hold no more she was headed for home and the men were paid off. They separated for their respective homes in Plymouth Hoe, Biddeford and ruddy Appledore where some became farmers and others, true to the salt in their blood built up a highly remunerative smuggling business. The vessel was scrapped and the brass cannon and other fittings were remelted and cast into new pieces of ordnance.

"Some time afterward the notorious Captain Flint, tired of honesty is the best policy—good, but too slow—decided to do a little pirating on his own account. The little pal constantly reminded him in her letters that her life was a frost. She simply could not do any entertaining on his meager captain's salary. Chivalrous to a degree our hero determined to remedy the situation. His little woman was going to ruffle it with the best of them. Dash it all—double dash it—by the great horny hoofs of Neptune he would restore her confidence and show her he was a he-man and give her everything her sweet, girlish heart desired. None of these slick Janes was going to put anything over on the little pal. No sir, begad, not if he knew it!

GENUINE RUSSIAN ANTIQUES—FROM NEXT DOOR

"He secured a vessel and a crew by the simple expedient of pushing all conscientious objectors overboard. He casually picked up stores and equipment here and there including our nice new brass cannon and then hurried to the Carribbean where fortune smiled upon his ventures. All ready to return with wealth to pour into the lap of his lady love he learned she had hooked it, in other words flown to the continent with a gay young sprig of the nobility. His honest old heart was broken. He took to the cursed drink and died in the horrors in Savannah. His vessel was captured, taken back to England and the crew were hanged handsomely on Execution dock.

"After a considerable period of active service afloat and ashore our brass cannon came to America in the war of 1812 and was abandoned near New York at the close of hostilities. It remained in a government junk yard for a considerable period. Following the almost universal adoption of cast-iron guns it was sold with other accumulation of brass and bronze scrap to a dealer in old metals and eventually found its way into the yard of a brass rolling mill where it was broken up, remelted and cast into billets.

"The billets were rolled into bars and sheets and later converted into a myriad of objects distributed over a wide territory. Defective product, scrap, clippings and other miscellaneous residue was sold to a junkman who later sold it to a brass foundry located on the sixth floor of a loft building in New York city. Here it was converted into genuine imported Russian candle sticks and other objects of art for the benefit of tourists who go shopping in Allen street for antiques and other thrills.

"Although the castings only had left the molds a week or two previously, still in a manner of speaking they were antiques since in some instance the metal originally may have formed part of a column in Solomon's temple. Isn't it a rather odd coincidence that in this, the latest reincarnation after a period of over 2000 years, the metal should be sold by descendants of the same people for whom it was originally cast into enduring shape?"

"Yes" I said "odd, but extremely improbable."

Firm Is Reorganized

Belle City Mfg. Co., Racine, Wis., manufacturer of individual threshing outfits, crawler attachments for tractors and other agricultural specialties, has been reorganized, and with the introduction of new capital, operations have been resumed. Capacity production is expected to be developed within 30 or 60 days. The new officers are: President and general manager, H. A. Reed; vice president, W. J. Tostevin; secretary-treasurer, George A. Nelson; assistant, H. A. Schultz. The firm was established in 1882 and except for 1925 and 1926 has operated successfully.

J. C. Fitzpatrick has been appointed district manager of sales, 1241 East Forty-ninth street, Cleveland, to succeed J. L. Westenhaver who has resigned to enter business for himself.

Permanent Molds Antedate Caesar's Legions

Museum Specimens Prove Early European Study of Casting Methods—Repetition Work Was Goal of Ancient Craftsmen in Copper and Bronze

By John P. Frey

BEGINNINGS of the metal molder's trade are shrouded in mystery. The art of casting metals was known before the day when men had an alphabet and the art of writing, so that a record of what they did could be handed down to posterity.

We have no account of how molds first were made or of the molder's trials and tribulations. The first molds may have been of baked clay, but at some early period fine grained sandstone and some other stones were carved into molds, and from these fine specimens of molders' skill were produced.

While the writer was in Geneva, Switzerland, recently, he visited the city museum which contains a large collection of castings from the early bronze age. Most of these are of celts, a small battle axe. In the collection are many spear heads and a few knives, daggers, and fish hooks, these having much the same shape as the fish hook of today. There also are a number of bronze rings.

The most astonishing objects are the stone molds from which many of these castings were made. Apparently, the stone mold had been made by working two pieces of stone until they had a thoroughly flat surface. Holes then were drilled through them at the edges, through which dowel pins could be placed and one half of the mold was carved on each piece of stone. When the two parts of the mold were put together, the dowel pins inserted, and the whole clamped together and probably heated, the mold was ready for pouring.

Some of the stone molds show that they have been used many times, for that part of the surface into which the metal was poured is burned black, so thoroughly burned that the color remains even though the molds were underground for four or five thousand years.

It is evident that the primitive molder found considerable trouble with his first molds, for the vent was not sufficient and the gases created in the mold prevented the metal from filling it, and in all probability also caused the mold to blow at times, or produce spongy castings. In any event, the molder finally discovered that a vent was necessary, and perhaps a little more than a mere vent, for the stone molds show vent holes which are large enough to flow metal through so that perhaps the primitive molder flowed the metal through the mold for a short time before stopping up the vent.

These early molders made astonishing progress, for they learned to gate much of their small work. Many of these stone molds contain as many as 12 castings. The gating is much the same as today. A large channel

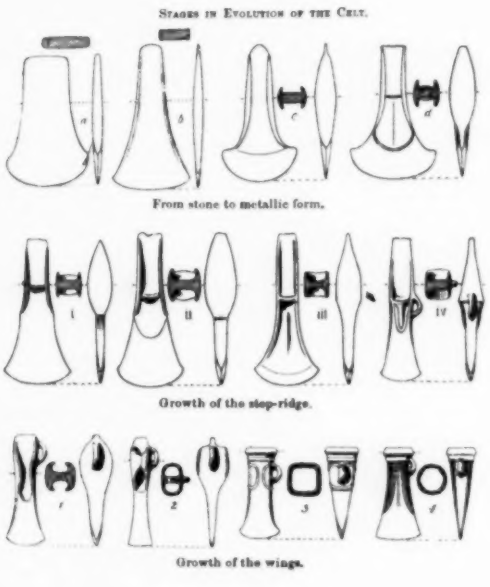


Fig. 1—Left—From the catalog of the British Museum, London, England, indicating the evolution of the stone celt to a more enduring tool or weapon of bronze and the manner in which the form altered as the bronze molder developed his skill until he reached the discovery of how permanent metal molds could be made

Fig. 2—Right—Early celt preserved in the British Museum. This celt was discovered at Beachy Head, Sussex, England. It shows the manner in which the two flanges or wings were bent together, forming a strong loop to hold one-half of the handle

Abstracted from an article in the *International Molders' Journal*. The author who formerly was editor of that publication now is secretary of the metal trades department, American Federation of Labor, Washington.

A LEXICON OF TECHNICAL TERMS

By O. W. Potter

(*Continued from Data Sheet No.* 686)

Elongation

Ratio of linear deformation to original length. It is usually expressed in per cent. This is also called permanent stretch, stretch, or extension.

Examples:

Material	Per cent
Wrought iron	30-50
Mild steel	10-40
Alloy steel	5-50
Malleable iron	10-15
Gray cast iron	½- 2

Reduction of Area (Contraction)

The difference between the original area and the area at the point of rupture when ruptured by tension. It is expressed usually as the ratio of the reduced area to the original area and most commonly is given in per cent.

This is also called contraction of area, contraction of section, or struction.

Examples:

Material	Per cent
Wrought iron	40-60
Mild steel	45-60
Alloy steel	2½-60
Malleable iron	15-25
Gray cast iron	1-2½

Transverse Deflection

The total amount of deflection from the original position when stressed by transverse loading. This is also called transverse strain, transverse deformation, detrusion, strain deflection, or deformation due to transverse loading.

The values depend on the shapes of the test specimens, the location of the load and the distance between supports of the specimen when tested.

In testing brittle materials such as cast iron, the deflection of a standard bar 1½ inches in diameter when supported between 12-inch centers and loaded at the center runs from 0.10 to 0.15-inch. Annealing will increase the deflection.

Permanent Set

When a material is stressed beyond its elastic limit there is a partial return to the original form upon removal of load. The permanent set

(*Continued on Data Sheet No.* 690)

A LEXICON OF TECHNICAL TERMS

(*Continued from Data Sheet No.* 689)

is the amount of distortion remaining after the load is removed and the elastic recovery completed. The rate of loading greatly influences the amount of permanent set.

Critical Strain (Critical Deformation)

The maximum strain due to mechanical working which will not cause grain growth of that strain. This will vary with different temperatures of the same material.

Resilience (Elastic Resilience)

The energy of a substance which causes the deformed shape due to stress to return to its original shape. This occurs only when stressed below the elastic limit.

Therefore, depending on the nature of the stress we may have compressive, tensile, shearing, bending, flexural, or torsional resilience. (See Modulus of Resilience.)

Modulus of Elasticity in Compression (Compressibility)

The ratio of load to deformation or unit load to unit deformation below the elastic limit when stressed in compression.

Examples:

Material	Compressibility
Wrought iron	25,000,000
Steel	29,000,000
Malleable iron	22,000,000
Gray cast iron	14,000,000

Usually slightly lower than modulus for tension.

Modulus of Elasticity in Shear

The ratio of the shear load to the shear deformation or unit shear load to unit deformation below the elastic limit.

Examples:

Material	Modulus in Shear
Wrought iron	10,000,000
Steel	12,000,000
Cast iron	6,000,000

The modulus of elasticity in shear is usually about two-fifths of the modulus of elasticity in tension.

(*Continued on Data Sheet No.* 691)

THE FOUNDRY DATA SHEET, OCT. 15, 1927

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Fig. 3—Left—Permanent bronze mold for casting celts. The two parts of the mold were kept from shifting by the tongue on one half and the corresponding lip on the other. This mold was found at Hotham Carr, East Riding, Yorks, England

Fig. 4—Right—This mold in its finish throughout is the most perfect which archaeologists have uncovered. The two halves of this mold were prevented from shifting by the flange on one half which fitted into a corresponding groove on the other. Found near Amiens, France

to carry the metal is cut through the center of the mold, from this main gate a smaller one leads to each casting, and from each casting a vent is carried to the edge of the mold.

While in London, Eng., a number of visits were made to the British Museum and here came the most astonishing discovery. The prehistoric molder had gone much farther than sand and stone molds. He had learned to make a permanent metal mold of bronze from which to make bronze castings.

Photographs of a few of these molds were secured from the authorities of the British Museum. They are reproduced in connection with this article. These permanent metal molds show a development in the prehistoric foundry industry which serves to indicate how man continually attempts to improve upon what he already knows by developing new methods processes, and more efficient tools.

Judging from the remains which have been found the celt, or small axe, was one of primitive man's most important tools and weapons. He probably used this axe to cut wood, to hunt game, and as a military weapon. From a simple cutting slab this tool was developed until it became a beautifully formed, socketed axe, capable of much service. Yet great as was the development in the form of this tool, to make it more serviceable, the prehistoric molder did not carry his axe making to the point where a hole was made through the axe head so that the haft of the handle could be inserted and fastened.

Fig. 1, taken from the "Guide to Antiquities of the Bronze Age," published by the British Museum, shows the evolution of the bronze celt. The original type is shown at the upper left-hand corner, the side, end and the cross section of the celt being shown. It was a serviceable tool or weapon, but it had limitations, for it

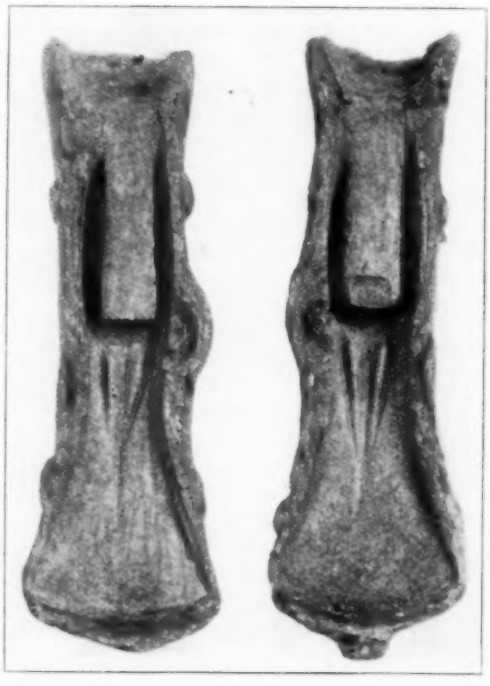


Fig. 5—Left—A permanent bronze mold for casting celts or palstaves. This mold shows the difference between the fine finish of the mold and the roughness of the joint. Found in Wiltshire, England

Fig. 6—Above—This illustration from the original in the British Museum shows the central part of multiple mold for making bronze spear heads. It is made of fine grained sandstone. Found at Lough Gur, Co. Limerick, Ireland

was lashed to the wooden handle with thongs, and these were all that held it. In all probability these thongs would give after a few vigorous strokes had been made, and in damp weather the thongs must have become quite soft and yielding. Efforts probably were made to back the head of the axe in the handle so that the force of the blow would not be carried by the thongs.

However, wood splits easily. Without doubt on more than one crucial moment a few vigorous blows rendered the celt useless, and its owner had to fall back on more primitive weapons. If the handle stood up under the hard work required of it, then the blade of the axe might bend and so the idea of a strengthening flange developed, and we see this in the shape which the celt took in the two figures at the upper right-hand corner of the illustration.

The idea of the value of a flange grew and soon, in addition to the side flanges for strengthening purposes, a cross flange was made which prevented the celt from slipping through the handle. Finally, as shown in the bottom row, the celt developed two deep flanges or wings which were then bent together until finally some one discovered how to make the celt with a deep socket in the head and a ring at the side through which thongs could be passed to tie it securely to the handle.

Fig. 2 shows one of these celts with the ring through which the thongs passed and the two deep flanges which, after the casting had been removed from the mold, were hammered together, forming two strong openings through which the handle was inserted. The permanent bronze molds which have been found are all of this flanged type, none in the British Museum being of the kind in which a core must have been used to make a deep socket in the head.

These molds have a peculiar fascination. They indicate how the ancient molder working at his trade, continually was evolving new methods. The metal molds bear every evidence that they originally were made in baked clay or a fine clay sand. Just how the molders discovered how to make these molds will remain forever a mystery. The evolution from the sand or stone mold to the permanent metal mold must have been slow, and the first metal molds crude affairs, but that there was an evolution in the making and in perfecting of them is shown by the photograph, and the drawings reproduced from the catalog of the British Museum.

The exterior and the joint of the molds, Figs. 3, 4 and 5 show the evolution which took place. The face of the mold itself, in each instance, is perfectly smooth, and with a good draft for all parts of the mold including the flanges. The joint is not perfectly smooth, and the joint and the method of keeping the two halves of the mold from shifting, help us to understand some of the primitive molders' problems.

The molder must have understood making a false mold for Fig. 3 shows that after a rough joint had been made several lips were cast upon one-half, the pins being cast on the other.

Fig. 4 shows a much superior example of workmanship. A groove was made through two-thirds of the joint on one-half, while a flange was made on the other, so that when the two parts of the mold were put together it could not possibly shift. These molds probably were heated before pouring. Quite possibly the molder may have learned to cover the face of the mold with a parting of some kind. He may even have learned the value of plumbago, although there is no evidence of this. Regardless of how he did his work, what tricks of the trade he was compelled to learn, there in the cases of the museum is the evidence that in prehistoric times the molder had learned to make permanent metal molds, and had carried on his art so extensively that a number of these have been discovered.

He also learned other things. Just as he had discovered the value of gating up small work so also had he learned something of mass production. Figs. 6 and 7 show a stone mold found near Lough Gur, County Limerick, Ireland, which indicates that before St. Patrick's day, the multiple mold had been evolved. This mold may be studied more closely in Fig. 7 in which the details may be seen more clearly.

This stone mold was made to produce four spear heads at one pouring. Two prehistoric Irish spear heads reproduced in Fig. 8 show their general appearance and finish. It is quite apparent from Fig. 7 that there were

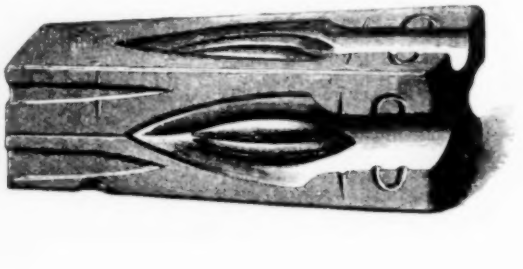


Fig. 7—Above—Stone mold for spear heads, Lough Gur, Co. Limerick. This woodcut of the stone mold for making spear heads shows clearly the vent or flow-off at the point

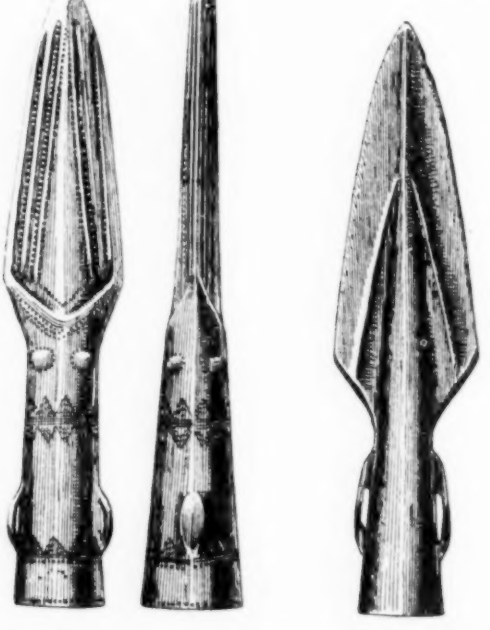


Fig. 8—Right—Cast bronze spear heads in the British Museum, discovered in Ireland. Note the lugs at the side for retaining the thongs provided to to bind the heads to the shanks

four slabs each with half of the mold carved in it. These were clamped to the four sides of the central mold. A glance at Fig. 6 will show that two small rings were cast at the shaft end of the spear head. These were placed there so that thongs could be passed through and tied securely to the spear shaft. Between the ring and the base of the spear are two small depressions. What these were for it is impossible to state. Perhaps they were small core prints so that a pin could be driven through the base of the spear fastening it to the handle.

The drawing of this multiple mold, Fig. 7, shows the vent or the flow-off from the point of the spear to the outside of the mold. If a flow-off, the metal must have been extremely hot to flow through, yet if the stone mold was thoroughly heated before the metal was poured in, some little flow-off would take place, and in any event all the gases created by pouring in the metal would be carried off immediately.

The primitive foundry had none of the equipment we find today. The casting cleaners had no pneumatic chippers, there were no grinding wheels or files to trim and finish the castings, yet we know something about how this work was done. At some prehistoric date a bog movement in Ireland overwhelmed one of these ancient foundries. Early in the last century another bog movement occurred at the same place, but this time the bog moved out and antiquarians discovered the site.

A large collection of castings and the tools with which they were trimmed and finished was found. These tools are all of stone, some flat to be used as files; some with a sharp edge which would cut through the gate, by the application of much elbow grease, and some concave or convex for grinding and polishing purposes.

What is particularly interesting is that these prehistoric molders had learned not only to make molds in sand, stone and bronze, but had in addition discovered the art of *burning in* broken castings. In the remains of this ancient foundry a number of swords, spears and sickles were found which had been brought to the foundry for repair. The broken ends had been put together in a mold in the same manner as the molder would apply today in an effort to burn in a broken casting. A large gate had been made with the necessary flow-off, melted bronze had been poured through until the broken part of the casting had been fused and as good a job done as any molder could do at the present time.

The prehistoric molder has left much evidence behind him to prove that he was ingenious, and that in his day and age progress was made in molding, from the simple mold to gated up work, and finally the development of permanent metal molds.

We salute our brother molders of prehistoric times! They proved that they were mechanics in every sense of the word, and with the equipment at their disposal produced results which revolutionized the foundry practice of their day.

An Engineer Visualizes Foundries of the Future

(*Concluded from Page* 792)

der of elements, including the 21 new elements, new laws of gravity, basis for entirely new astronomical data, new laws of physics, and a host of other surprising and clarifying data.

"Russel points out that everything is in motion, all impelled by the same common impulse. All this motion is identical for every phenomena, chemical, physical, astral or terrestrial, and swings in circular or elliptical movement from one extreme to the other and back again, in accordance with what he calls his *Cosmic Pendulum*. He charts the movements of the elements as they progress from one stage to the next or as we know them, from one element to the next element.

"His charts show the swing of this pendulum for the elements, starting at the extreme of one swing with Alphaon, 19 points or elements below Hydrogen, and swinging back and forth through an increasing oval to its maximum size then decreasing to its original size where we find Omegaon. Every place the pendulum crosses the bottom of its swing, or the point of equilibrium, we find those baffling elements that we used to know as inerts. As the elements swing, so swing all other phenomena. As hardness swings to softness, so swings the degree of ductility, conductivity, strength, color, tone, or any other attribute.

"To locate a metal on Russel's chart also is to locate all of its characteristics, or as we reverse it here to locate a characteristic is to locate the metal. These four dials serve to tell us at all times just what grade of metal is in the ladle. We do not take it in terms of carbon or silicon or even sulphur, but take it as the metal itself. Cast iron in its molten state is homogenous with all elements in complete solution, and in this state we ing of electrical conductivity and These dials give a combined read-record it in numerical numbers. electrospectral reaction for the metal in each ladle which is indicated on the dial as a numerical number.

"The operator or control man watches the dials and increases or decreases the flow from the reservoir ladles so that the mean of the three main dial readings will give him the required grade of metal that we must have as indicated on this fourth and last dial. The last furnace or preheater serves to blend the three metals and raises the temperature about 200 degrees above the normal melting point of the metal. This increase is necessary to pro duce the grade we turn out."

This is the first of two articles. The second will appear in an early issue.

Recognize Services on International Committee

At the closing session of the foundry convention which was held in Paris on Sept. 10, Paul Ropsy, president of the international committee of foundry associations and president of the Association Technique de Fonderie de Belgique, was presented with a work of art in bronze in recognition of the valuable services which he has rendered to the foundry associations in connection with the formation of the international committee, of which he is the first president. In thanking the congress for their gift, Mr. Ropsy said that he had much enjoyed undertaking his duties as president of the international committee, and that when he is succeeded next year by Dr. Werner of Germany, he will not cease to follow with the greatest interest the activities of the organization.

Desires Catalogs

Jainee & Co., Singapore, Straits Settlements, seeking to introduce modern methods in the foundry which the company operates desires catalogs on the following equipment: Pouring devices, handling ladles up to 300 pounds; electric cranes of 1-ton capacity; small electric polishing, grinding, drilling and chipping tools; electric welding equipment; small molding machines; refractory clay and sand.

An invitation is extended to foundry supply or equipment representatives who may touch at Singapore to visit the plant of the company.

Skimmer Gate Keeps Out Dirt

Describes Simple Inexpensive Type of Gate Which May Be Applied to Any Pattern or Pattern Plate—Insures Clean Iron in the Castings

By H. N. Tuttle

OCCASIONALLY a particular casting, particularly one that is finished all over gives a great deal of trouble on account of defective areas due to dirt that floats into the mold with the iron. If the casting is ordered in large quantities and if the standard style of gating does not prevent this form of trouble, it is advisable to design and apply a special gate.

An example of this kind is shown in Fig. 1, four 5-inch pistons grouped around a central runner and poured through a single gate on each piston, located at the side of the top or closed end. Fig. 2 is enlarged section of Fig. 1 and the letters indicating corresponding parts are the same in both cases.

In the drawing the four castings are marked *A A*, the parting line *B*, the sprue *C* and the boss in the center on which the sprue rests is marked *D*. The iron pours down the sprue *C* and spreads over the disk *E* which is only ⅛-inch thick except for a slight depression in the center. After spreading from the center the iron rises in the ring *F*. Any light foreign material remains on top and the clean iron flows into the castings through the small gates *G G*. Both the corner of the boss marked *H* and the ring *F* act as dirt catchers. In Fig. 2 the parts in the cope are shown cross hatched in one direction, while those in the drag are shown cross hatched in the other. Since this gate was introduced dirty castings have disappeared.

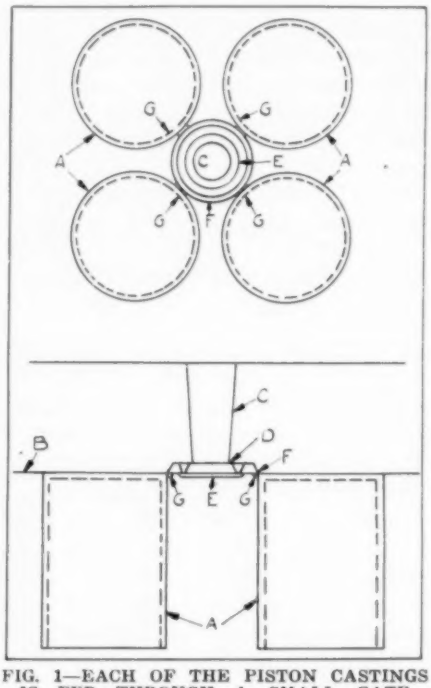


FIG. 1—EACH OF THE PISTON CASTINGS IS FED THROUGH A SMALL GATE

Another special gate is shown in Fig. 6 in which the casting, *Z* a brake drum, is shown in one cross hatching, while the brass gate *S* is shown in another. The sectional view below is taken on the line *O P*. The gate, a brass spider is well fastened into the pattern so that it may serve as a draw plate. This iron rising over the hump *K* leaves any floating dirt in the upper corner *T* before it enters the mold through the thin choking gate *V*.

In many foundries the custom still prevails of putting both gate and runner on the drag side of a matchplate. This constitutes an invitation to trouble and practically never should be done. Almost without exception the gates may be placed on the drag side.

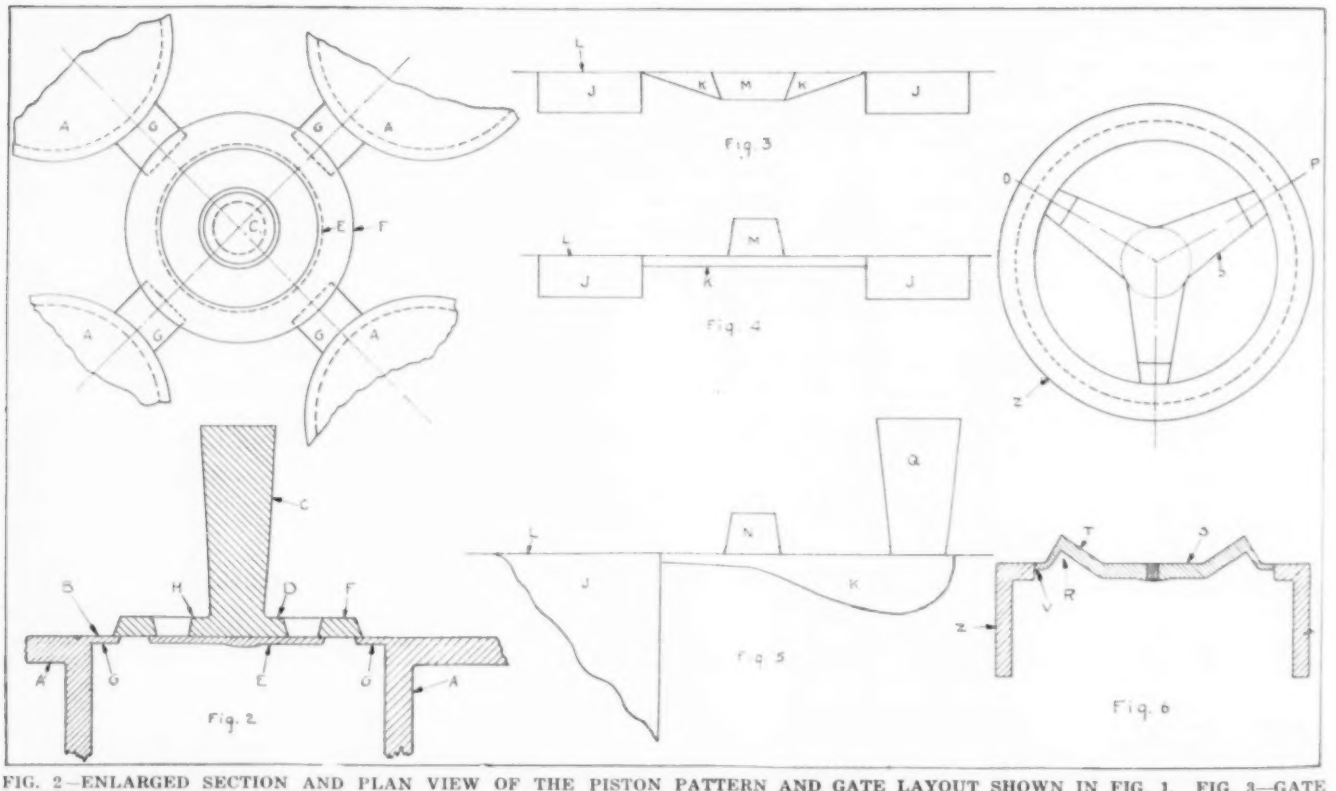


FIG. 2—ENLARGED SECTION AND PLAN VIEW OF THE PISTON PATTERN AND GATE LAYOUT SHOWN IN FIG. 1. FIG. 3—GATE AND RUNNER BOTH IN THE DRAG. FIG. 4—IN THIS PREFERRED METHOD THE GATE IS IN THE DRAG AND THE RUNNER IS IN THE COPE. FIG. 5—SHOWING APPLICATION OF THE DIRT CATCHER PRINCIPLE TO A LOOSE PATTERN. FIG. 6—A DIRT CATCHING SPIDER GATE FOR A BRAKE DRUM

In special cases, for example where they may be needed to prevent shrinkage, the gates may be placed on the cope side of the plate but this is exceptional.

The old method of placing both runner and gate on the drag side is shown in Fig. 3. An improvement in this method by which the gate is placed in the drag and the runner is placed in the cope is shown in Fig. 4. In both of these figures *J J* indicate two castings, *M* is the runner, *K* is the gate and *L* is the parting line between cope and drag with the gate on both sides.

Usually the gate shown in Fig. 4 may be made from 1/16 or ⅛-inch brass or aluminum and is easier to fabricate than the gate shown in Fig. 3. The runner in the cope not only acts as a dirt catcher but also helps to hold up shrinkage. Where the gates are cut by the matchplate molder, one style presents no more difficulty than the other in the actual cutting.

This precaution of adding a dirt catcher to the runner on an ordinary floor or bench mold may be carried out as shown in Fig. 5. The parting line is marked *L* and the pattern, sprue, gate and dirt catcher are marked respectively *J*, *Q*, *K* and *N*. The pattern *N* either is placed on the joint a short distance back from the gate entrance or a corresponding cavity is cut in the cope after the mold is separated. Where several gates are fed from a long runner this dirt catcher may take the form of a long stick on the cope side which crosses all the gates as close as possible to the patterns.

Readers Comment

Note—Material appearing under this head does not necessarily reflect the opinion of The Foundry or of its editors.

Desires Explanation

To the Editors:

I note in your Sept. 15 issue on the insert *A Lexicon of Technical Terms*, you show a diagram entitled "Soft Steel in Tension." This graph appears to show the ultimate strength between 75,000 and 77,000 pounds per square inch, while the breaking load is indicated as 68,000 to 69,000 pounds per square inch.

It is not just clear to me what is meant by showing the breaking load as less than the ultimate strength.

Yours respectfully,
W. A. E. Doying.

Washington, D. C.

Your difficulty in correlating the lower breaking load to the ultimate strength is due to an error in labeling the ordinate of the chart. Instead of the load being in pounds per square inch, it should be *LOAD IN POUNDS*, and only refers to the load applied.

To convert this value into unit stress, the area of crosssection of the test piece would have to be known. The ultimate unit stress or as it is known ultimate strength may then be obtained by dividing the value at the highest point in the load curve by the area of the test piece.

As the load on a bar in tension is increased, the piece stretches and becomes smaller in diameter. It also gains strength due to the cold working of this stretching process. However, after a certain point necking of the bar becomes pronounced and the crosssectional area decreases considerably. Therefore, the load may be decreased, and this is shown by the downward slant of the curve in the diagram. Actually, if the area at the fracture is computed and the load divided by this value, the breaking unit stress will be much higher than that ultimate unit strength. For example: Area of piece before pulling 1,213 square inches; Ultimate load 74,600 pounds. Calcuations:

$$\frac{74{,}600}{1.213} = 61{,}500 \text{ pounds per square inch} = \text{ultimate unit stress.}$$

$$\frac{66{,}250}{0.60} = 110{,}416 \text{ pounds per square inch} = \text{breaking unit stress.}$$

The Editors.

Presents Standard Car Wheel Analysis

To the Editors:

On page 729 of The Foundry, Sept. 15, under the question for specifications for gray iron car wheels, you state that there is no such thing as a standard analysis for chilled car wheels.

If you will refer to the American Railway association specifications, you will note that the chemical specifications for this particular class of castings are given as follows:

	Per cent
Combined carbon (maximum)	0.90
Sulphur (for 1927-8)	0.15
for 1929 and after	0.14
Manganese (minimum)	0.50
Total carbon (minimum)	3.35
Phosphorus (maximum)	0.35

Nearly all railroad specifications now have included the chemical analysis recommended by the American Railway association in specifications revised since 1923.

An average analysis of samples taken from 1000 wheels worn out after a long period of service, and representing 20 different manufacturers follows:

	Per Cent
Silicon	0.63
Sulphur	0.15
Phosphorus	0.32
Manganese	0.54
Graphite Carbon	2.82
Combined carbon in plate	0.60
Total carbon	3.42

H. W. Ufer

Chicago

Casting Leaks Because of Faulty Cores

Question: We shall appreciate your opinion on the probable cause of some leaking castings which apparently are perfect until tested under 150 pounds cold water pressure. The casting is known as a buck and is used in tailor shops for pressing clothing. We mold it flat face down with the core hung in the cope and we pour the metal through skim gates at both ends. The core is made from a coarse grade of sand bonded with oil and the vent appears to come away freely. We mix enough scrap with our No. 2 X foundry iron to close the grain to a point where the casting barely is machineable.

Answer: The core is responsible. It is entirely surrounded with iron with the exception of the small openings through which it is connected to the cope. If the core were perfectly plain the gas probably could escape in time through the regular vents provided, but in this case the ribs extending through the core complicate the problem by bringing the iron into more extensive contact with the surface of the core and therefore producing a greater volume of gas. The excess gas is not sufficient to produce visible blowholes, but it is sufficient to create a porous area at the highest point on the mold. Make the core from sharp sand *exclusively*, bonded with a minimum of binder and make the vent openings as large as possible.

WHAT OTHERS ARE THINKING

Abstracts Selected from the World's Foundry Literature

Desulphurizes Cast Iron

Upon the Effect of Alkalies on Iron Baths, by P. Bardenheuer and H. Ostermann, *Die Giesserei*, Muenchen, Germany, May 7, 1927.

The authors carried on investigations of the desulphurization of cast iron, using irons with and without silicon and manganese, and using soda and soda mixed with alkaline earths, and with ferrosilicon for the desulphurization agent. When no silicon is present in the iron no sulphur removal takes place, and when silicon is present, a reduction of both silicon and sulphur occurs. Therefore the authors suggest the incorporation of ferrosilicon with soda to eliminate silicon losses.

Mixtures of soda and calcium carbide were tried and it was found that desulphurization increased without an increase in silicon loss. Temperature has an effect on the desulphurization; with hot melting and consequent fluid iron, desulphurization takes place. However, with extremely high bath temperatures, the akali is evaporated without sulphur removal.

The finish of the reaction is evidenced by a quiet slag. Sometimes further additions of the alkali will remove additional sulphur. To obtain full benefit of the alkali, and have the best metal for casting, the reaction should go to compietion. The higher the sulphur in the metal, the greater the reduction. The authors conclude that treatment of the iron bath with alkalies decreases sulphur quickly. It has disadvantages of slagging off silicon and temperature requirements that may restrict employment.

Studies Decarbonization

Study of Phenomena of Decarburization, by M. Leroyer. *La Revue de Fonderie Moderne*, Paris, June 10, 1927.

This is the second part of the article by M. Leroyer on malleable iron. In practice the oxygen used for the process of decarburization comes from decomposition Fe_2O_3, generally hematite. The author summarizes the results of previous studies on the subject and mentions the study made by Hatfield on the original Reaumur process used in the British method. Hatfield's conclusions are, that the process of malleablization presents two phases: First, the elimination of the carbon from the outside parts of the casting, and second, the precipitation of graphite inside the casting.

The author reviews the influence of the various elements of decarburization, taking carbon, silicon, sulphur, manganese and phosphorus. He then deals with the influence of time, temperature, the oxidizing power of the ore and the thickness of the casting. He points out that in the American method there is a certain amount of oxidization and in the European method a certain amount of graphitization. For the study of these two processes two particular types of cast iron were investigated. In France malleable iron is made with cast irons of varying compositions, carbon ranging from 3 to 3.60 per cent, manganese less than 0.40 per cent, phosphorus less than 0.10 per cent, sulphur between 0.12 and 0.25 per cent, silicon between 0.40 and 1.20 per cent, the amount of silicon varying with the thickness of the casting and the carbon content. In fact, these various compositions of cast iron can be used for obtaining malleable iron, providing that the original metal after pouring contains no graphite, and that the conditions under which pre-heating or annealing is effected are such that the final iron is constituted wholly of ferrite as in European malleable thin castings, or by ferrite containing carbon in nodules as in American malleable cast iron, or of ferrite, pearlite and graphite as in European malleable iron for thick castings.

Analyzes Brass by Volatilization

Rapid Brass Analysis, by St. von Bogdandy and M. Polanyi, *Metal Industry*, London Sept. 2, 1927.

The process is based on the differential volatility of the constituents of commercial brass. The apparatus consists of a cylindrical container of quartz glass which is connected to a high-vacuum pump. An electric heater with a platinum winding previously heated to 1190 degrees Cent., is placed around the quartz glass container. Coarse drillings, chips or shot are used as the sample, which runs from 150 to 200 milligrams in weight. The sample is heated for 6 minutes, the heater removed and the container cooled in water. The sample and its containing cup are weighed. The loss in weight is that due to the volatilization of zinc and lead. Lead and zinc which have been volatilized from the original sample and condensed in a cooler portion of the apparatus further may be separated by volatilization and an estimation made of the amounts of these two constituents. A temperature of 600 degrees Cent. is used in separating lead and zinc; the lead remains and the zinc is expelled.

Gives Cupola Data

A Comparative Study of the Operation of Cupolas, by M. Poumay, Jr. *La Revue de Fonderie Moderne*, Paris, May 25, 1927.

This article gives the results of a comparison between ordinary cupolas, cupolas with exceptional power of production and the cupola designed by Adolf Poumay of Jambes-Namur, Belgium. This cupola was described in *La Fonderie Moderne* of August, 1926. Results are shown by a comparison of the heat balances of the three different types of cupolas. It is shown that in the ordinary furnace a certain amount of oxygen is not used for the combustion of carbon but oxidizes the elements of the metal. The re-actions thus obtained are exothermic and result in a certain economy of fuel, but this economy is more than neutralized by an excessive loss of metal. The drawbacks of an oxidized operation are, a heavy loss in melting, a change in the composition of the metal; the metal is hot but freezes rapidly, and there are numerous discards from the finished casting.

According to the author, the results of the comparisons tend to show that with this type of cupola little oxygen escapes through the top.

Describes Blackheart Process

Air Furnace Practice, by Christian Kluijtmans, *Foundry Trade Journal*, London, Sept. 1, 1927.

This is the first section of an article on the production of blackheart malleable iron and the author presents data on the furnace design, composition of the charge, a description of the irons used in the charge, and the initial charge. The furnace used by the author has a capacity of 15 tons and has the following dimensions: Length of bath, 25 feet; width, 8 feet; depth, 6 inches; size of grate 5 feet 3 inches by 8 feet; ratio of grate to bath area, 1 to 5; blast pressure, 4 inches.

Irons carried in the stock pile are white hematite pig iron with wide range of silicon and manganese with limits as follows: Total carbon 2.90 per cent; silicon, 0.80 per cent; manganese, 0.30 per cent; sulphur, 0.05 per cent; phosphorus, 0.06 per cent. Gray iron (limits), total carbon, 3.90 per cent; silicon, 3.45 per cent; manganese, 0.90 per cent; sulphur, 0.03 per cent, and phosphorus, 0.11 per cent. Some higher phosphorus iron is kept on hand to bring phosphorus to required content and this may reach 0.22 per cent without serious harm. Steel scrap in the form of bloom ends or rails are used. More than 0.10 per cent chromium in steel causes annealing difficulties. Nickel does not interfere but seems to improve the metal. Following this information the author gives some terms employed in melting and some of the steps taken during the melting of the first charges to obtain data for future use in calculating the furnace performance.

Analyzes Loam

New Quantitative Method of Analysis of Loam, by Dr. O. Macchia, *La Revue de Fonderie Moderne*, Paris, July 10, 1927.

Describes a new gravimetric method of analyzing magnesia, lime, iron and alumina in loam, which gives quicker results than the commonly used methods. The author is attached to the laboratory of chemistry of R. J. Industriale, Livorno, Italy.

The FOUNDRY Family Photograph Album

Upper Left

F. G. SMITH, Osborn Mfg. Co. Cleveland

Lower Left

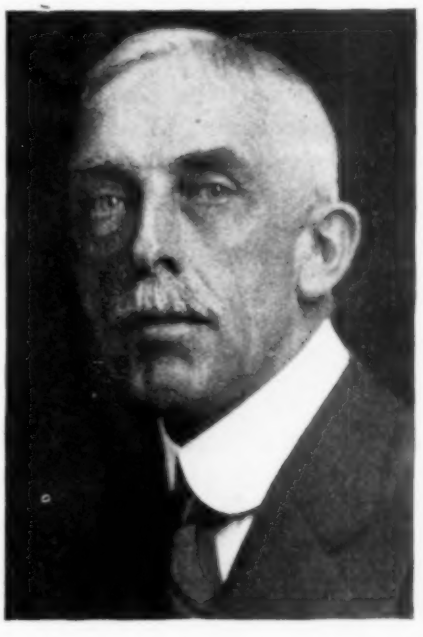
DAVID C. PARK, Smith & Caffery Co., Syracuse, N. Y.

Upper Right

C. E. HOYT, American Foundrymen's Association, Chicago

Lower Right

A. E. BARLOW, Barlow Foundry Inc., Newark, N J.



The Shakeout

DAN M. AVEY, Editor

PAT DWYER, Engineering Editor
FRANK G. STEINEBACH, Associate Editor

CHARLES VICKERS, Nonferrous Editor
EDWIN BREMER, Associate Editor

¶ Industry Against Industry

THIRTY years ago, Mr. Householder devoted considerable time and thought to the expenditure of a sufficient sum to buy a new base burner for the front room. Needless to say, his money was in hand. His family had made him appreciate the urgent need for this heating unit, and no other major outlay offered itself for his consideration. He visited the local hardware and furniture stores, selected the stove which was recommended to him or which his wife thought would look best in the parlor, and the transaction was closed.

THIS fall, the oldest son of Mr. Householder, remembering the struggle he had last winter with his balky furnace, determines in his own mind that he should have a new one. He recalls the advertisements in various periodicals that have shown diminutive infants or perhaps the family pup successful firing a large heating unit in a spotless basement where inviting chairs and a billiard table carry out the club room illusion. He broaches his plans to the family, but Mrs. Householder, Jr., counters his lead with a firm demand that the house be painted before the snows come again. The daughter announces that she refuses to entertain even casual friends unless their archaic radio is replaced by a new super-super model. Further, the son states that he won't return to Tech unless he can replace his collegiate fliver with a new snappy speedster. Probably the urgent needs of the entire family will be supplied, if the family budget can be stretched to cover the monthly payments.

NO IMAGINATION is needed to find this family financial problem encountered in thousands of households throughout the country. Plentiful as money seems in the average American household, the competition for each monthly payment is becoming increasingly severe. A new bathtub may loose the argument to an electrical refrigerator, or sister's new piano may have to wait its turn until the payments on mother's washing machine have been completed. Competition between different items common thirty years ago has been lost in the greater struggle between great classes of commodities.

SIMILARILY, the narrow battles between individual manufacturers have merged into greater campaigns between products. Cement, brick and asphalt drive through series of engagements all along the line for supremacy in road construction. Steel and reinforced concrete dispute the crossing of each stream in their active efforts to secure each new bridge contract. Brick and lumber bring arrays of figures to win every skirmish over a new home. Forgings, stampings and rolled products exert every strategy to secure new outlets at the expense of the castings manufacturer. Truly this is an age of competition between industries. Those industries whose members sink petty and individual competition in every battle for the common good, alone will survive.

¶ Check Your Practice

BEFORE beginning on a mad hunt to find some secret alloy, mixture, compound or what have you, that will cure all the ills of iron and make it produce good castings, the foundryman should investigate his melting practice. First, the materials entering in the cupola should be of good quality. A miscellaneous hodge-podge of burnt scrap, chilled iron, malleable scrap and off-grade pig iron will not produce good gray iron no matter what is used for a physic. After seeing that the metal is such as will produce good iron, the coke quality should be examined. Sulphur content should not be high. The coke should not be friable or it will not bear the burden of the iron charges. At the same time it should not be so dense that it will not burn properly. Then see that the cupola is daubed properly to give good interior lines, and not have the daubing slough off after heat is applied. The height of bed, volume of blast, weight of iron charge, and coke to iron ratio to give the best results should be determined. It may take a little time to check these points, but the results are worth the trouble.

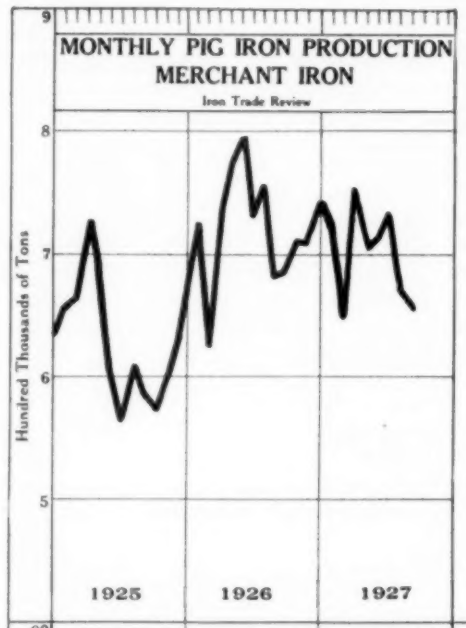
Trade Trends in Tabloid

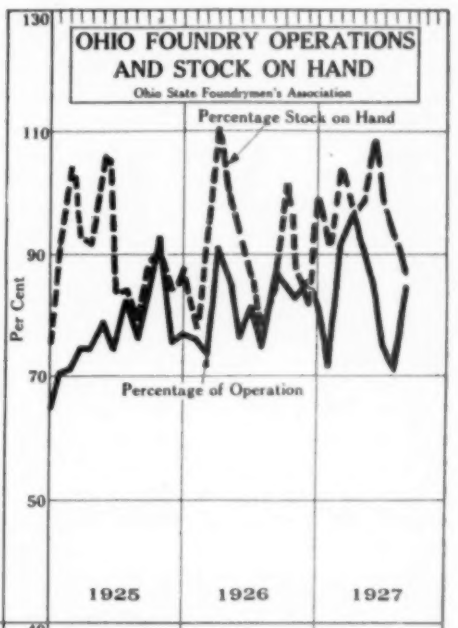
IMPROVEMENT is noted in jobbing foundry operations, with the exception of those making automotive work. Production of automobiles, trucks and tractors has lagged during September. Anticipated changes in models among a number of makers has stopped specifications on a number of contracts. General business conditions are reported good. Freight car loadings have continued at a peak, but railway purchases have been extremely light. Cast iron pipe foundries are operating at from 60 to 75 per cent, with keen competition and skidding prices on each new contract of any substantial tonnage. Pig iron production for September, according to *Iron Trade Review* showed another slight loss, the sixth successive month in which the output has declined. The total of all classes of pig iron is given as 2,781,594 tons for September, compared with 2,950,674 tons for the preceding month. The loss on a daily average production basis is given as 2.6 per cent. Merchant iron output for August was 667,104 tons and for September was 650,342 tons. Average New York prices for nonferrous metals, during September according to the *Daily Metal Trade* were as follows: Casting copper, 12.922c; electrolytic copper, 13.211c; Straits tin, 61.445c; lead, 6.304c; antimony, 11.119c; aluminum, 25.375c. Zinc averaged 6.209c, E. St. Louis. Brass foundry operations are slow.

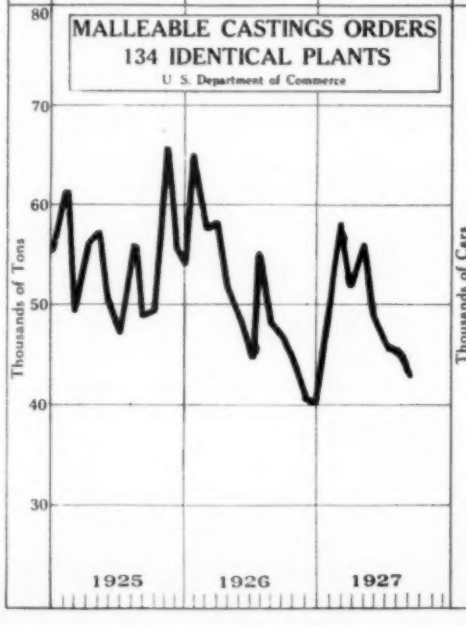
RAW MATERIAL PRICES

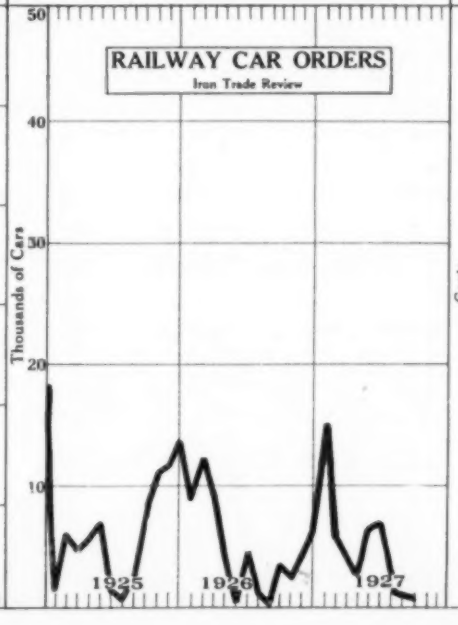
Oct. 7, 1927

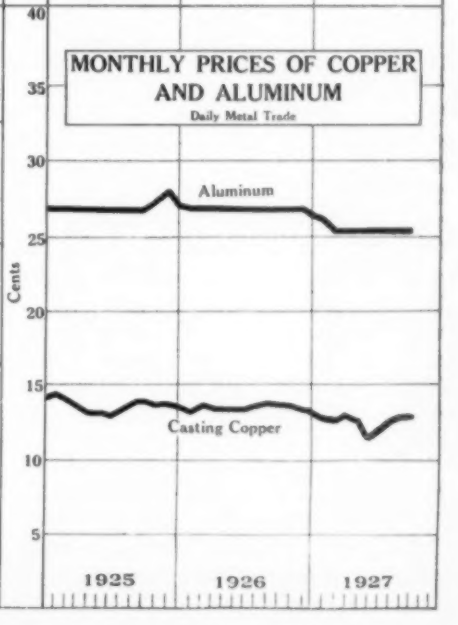
Iron	
No. 2 foundry, Valley	$17.50
No. 2 southern, Birmingham	17.25
No. 2 foundry Chicago	19.50
No. 2 foundry, Philadelphia	20.26 to 20.76
No. 2 foundry, Buffalo	17.00 to 17.50
Basic, Valley	17.00
Basic, Buffalo	16.50
Malleable, Chicago	19.50
Malleable, Buffalo	17.00 to 17.50
Coke	
Connellsville foundry coke	$3.75 to 4.75
Wise county foundry coke	4.00 to 5.00
Scrap	
Heavy melting steel, Valley	$15.50 to 15.75
Heavy melting steel, Pitts	14.50 to 15.00
Heavy melting steel, Chicago	12.00 to 12.50
Stove plate, Chicago	12.50 to 13.00
No. 1 cast, New York	13.25 to 13.75
No. 1 cast Chicago	14.50 to 15.00
No. 1 cast, Philadelphia	16.00 to 16.50
No. 1 cast, Pittsburgh	15.00 to 15.50
No. 1 cast, Birmingham	14.00 to 15.00
No. 1 cast, Buffalo	13.00 to 13.50
Car wheels, iron, Pittsburgh	15.00 to 15.50
Car wheels, iron, Chicago	13.50 to 14.00
Railroad malleable, Chicago	13.75 to 14.00
Agricultural Mal., Chicago	13.00 to 13.50
Malleable, Buffalo	14.75 to 15.25
Railroad malleable, Pitts	15.00 to 15.50
Nonferrous Metals	Cents per pound
Casting copper, refinery	12.90 to 13.00
Electro copper, producers	13.25
Straits tin	58.50
Lead, New York	6.25
Antimony, New York	11.37½
Nickel, electro	39.00
Aluminum, No. 12, producers	24.50
Aluminum, No. 12, remelt	18.50 to 19.50
Zinc, East St. Louis, Ill	6.00 to 6.05











Personal

Neil C. Lamont has resigned as manager of the Worthington Pump & Machinery Corp., Harrison, N. J. where he had been since 1925. Beginning in 1900 with the Cincinnati works of the International Steam Pump Co., predecessor of the Worthington organization, he became manager of the Cincinnati works in 1917. In 1923 he was placed in charge of the power and mining works of the company at Cudahy, Wis. Later Mr. Lamont was transferred to New York as assistant to the president in charge of engineering and manufacturing.

N. R. Crawford, for several years director of sales, Industrial Works, Bay City, Mich., has resigned.

O. B. Gridley and G. E. Gellerman have leased the plant of the Ulmer Machinery Corp., Santa Ana, Calif., and will operate it under the name of Mechanical Iron & Pipe Foundry.

Alfred G. Morency, formerly president, Northern Indiana Brass Co., Elkhart, Ind., has severed his connection with that firm and organized the Coldwater Brass Co., Coldwater, Mich. Mr. Morency previously was connected with the Morency-Van Buren Mfg. Co., Sturgis, Mich.

John Shaw, contributor of the British exchange paper at the Detroit convention of the American Foundrymen's association in 1926, has taken up his residence in his new home "Cartief," Southsea, England. Mr. Shaw has retired from active foundry duties and is devoting himself to study and research.

Is District Engineer

R. S. Kerns, formerly in charge of metallurgical research and instructor in metallurgy, Pennsylvania State College, State College, Pa., now is district sales engineer for the Acheson Graphite Co., Niagara Falls, N. Y. Mr. Kerns began his foundry career in the South Altoona foundries of the Pennsylvania Railroad Co. and later was a helper on a 100-ton open-hearth furnace at the Cambria Steel Co., Johnstown, Pa. From this position he went to the Draper Corp., Hopedale, Mass., as melting foreman and metallurgist in its gray iron foundry.

After Mr. Kerns held this position for a year and a half, he joined the Pittsburgh Electric Furnace Corp., Pittsburgh, as electric furnace erector and service engineer. Three years later he became associated with the Blackwood Electric Steel Corp., Parkersburg, W. Va., as chemist and metallurgist. After a year with this firm he became associated with the Pennsylvania State college.

Pittsburgh Foundrymen Hear Talk

The regular monthly meeting of the Pittsburgh Foundrymen's association was held on Sept. 19. E. T. Bennington, manager, tramrail division, Cleveland Crane & Engineering Co., Wickliffe, O., spoke on material handling in the foundry, and stated that a period of severe competition is approaching. Manufacturers without the proper organization and equipment to compete by giving a better product at a better price will fail. Material handling machinery offers the foundry an opportunity to reduce costs.

The system which is to be used must be planned before hand and not installed haphazard if the least rehandling and best results are to be obtained. Overhead conveying machinery is gaining favor as it is away from the dust and dirt of the foundry floor. It also utilizes the waste space between the ceiling and the men's heads. Mr. Bennington illustrated his talk with lantern slides showing the application of overhead systems in foundries and discussed the advantages and disadvantages of various arrangements.

Appointed Engineer

Harold E. White recently has been appointed ceramic engineer with the Lava Crucible Co., Pittsburgh. For five years after his graduation from Lehigh university he was affiliated with the Norton Co., Niagara Falls, N. Y., maker of abrasive wheels. For about a year he was ceramic engineer at the Electric Refractories Corp., Buffalo plant. For the past five years he has been with the Federal Phosphorus Co., Anniston, Ala., and its allied interests in various capacities.

Plan European Tour

American Ceramic society has proposed a lengthy itinerary for its European tour from May 19 to July 5, 1928. The party will leave New York on a Cunard liner on May 19 and arrive in Havre, France on May 28. From May 29 to June 3 will be spent in Paris. Lucerne, Switzerland will be visited June 4 and 5. On June 7 the party will be in Munich, Germany, and in Nuremburg on June 9. From Nuremburg the party will go to Karlsbad and then to Prague, Czechoslovakia. Three days, June 11, 12 and 13 will be spent in Prague. June 14 will be spent in Dresden and Meissen, Germany and June 15, 16 and 17 will see the party in Berlin. June 19 and 20, the Ceramists will visit Amsterdam, Holland with special excursions to Delft, and late on the 20th will proceed to England. The British ceramists will be hosts to the party on June 21, 22, 23 and 24. On June 25 a motor trip to the *Black Country* is arranged and from June 26 to 29 will be spent in Manchester, Sheffield, and Stoke-on-Trent. On June 30 the party will sail from Liverpool. Arrangements will be made for those who desire to remain in Europe and return at a later date.

Holds Sixth Meeting

Wisconsin Gray Iron Research group held its sixth regular monthly meeting in the Republican house at Milwaukee. R. S. MacPherran, Allis-Chalmers Mfg. Co., West Allis, Wis., spoke on cupola practice.

Approve Firms' Merger

Stockholders of the Brown Hoisting Machinery Co., Cleveland, and the Industrial Works, Bay City, Mich., have approved of the merger of the two firms which will be known as the Industrial Brownhoist Corp. with general offices at Cleveland. Alexander C. Brown is president of the new company which will operate plants at Cleveland, Bay City, Mich., and Elyria, O. The firms manufacture hoisting apparatus, steam shovels and similar heavy machinery.

Gives Equipment Sales

Eighteen member firms of the Foundry Equipment Manufacturers' association, Cleveland, report that during August equipment valued at $389,946 was sold. This is a gain of 18 per cent over that sold in July. Shipments during August according to 16 firms reporting were $426,654. Orders on hand Sept. 1 were $529,433 as compared with $731,649 on hand on Aug. 1.

Alexander Milburn Co., Baltimore, manufacturer of weldng and cutting apparatus, carbide lights, oil burners and preheaters, and paint and lacquer spraying equipment, has established an office in Boston which will be known as the Alexander Milburn Sales Co., and is located at 50 Terminal street. The office will be under the supervision of M. B. Crouse and G. B. Malone.

Reduce Core Binder

Question: Do you know if silicate of soda is used in any foundry as a core binder? If it is we will appreciate instructions on the proper amount to employ. We have been using a proprietary binder with considerable success, but have had some trouble due to scabbing. What kind of material can we add to the mixture to prevent this? We run a low temperature night oven in which the temperature runs between 300 and 350 degrees Fahr., and on this account we must use some form of binder other than oil.

Answer: We do not know of any instances where silicate of soda, commonly known as water glass, is used as a core binder. All the materials used for binding core sand have two characteristics in common. When raised to a certain temperature, between 250 and 500 degrees Fahr., depending on the material, they bind the grains of sand closely together and impart to the core the necessary strength to withstand the pressure of the metal. At higher temperatures caused by contact with the molten metal, the binding agent is consumed and the released grains of sand are free to flow from the casting. Sodium silicate is a form of glass, made from the same ingredients as glass, soda ash and silica sand. It might fulfill the first function to hold the grains of sand together, but later, on being raised to a high temperature it would fuse instead of burning away.

The material you are using for a core binder at present is used extensively and enjoys a favorable reputation. In fact all the proprietary core binders find favor among foundrymen, although it is quite true that individual foundrymen have their preferences. Probably the cause of your trouble is that you are using local sand and attempting to duplicate results achieved elsewhere under different conditions. Scabbed cores cannot fairly be charged against the binder since scabbing is caused primarily by gas that cannot escape. Where the sand is open and where auxiliary vent channels are provided if necessary, the character of the binder will not affect the face of the core. Without a knowledge of your sand and the shape and size of your cores we cannot suggest a suitable mixture, but in a general way we suggest you cut down on the amount of binder, use more sharp sand and vent the cores more thoroughly. All manufacturers of core binders maintain research departments and will be glad to develop a core sand mixture for you in which their binders may be used. All, or practically all manufacturers and foundry supply houses have pamphlets prepared showing typical mixtures of various classes of sand used successfully in many places. Upon application they will be glad to send copies of this literature from which you may draw your own conclusions and develop a mixture.

Faked Foundry Facts

Working at the Tub

Foundry Association Directory

American Foundrymen's Association

President, S. W. UTLEY, Detroit Steel Casting Co., Detroit; secretary-treasurer, C. E. HOYT, 140 South Dearborn street, Chicago; technical secretary, R. E. KENNEDY, 909 W. California street, Urbana, Ill.

The Buffalo Foundrymen
Buffalo

President, J. MCARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 146 Chandler street. Meetings the third Wednesday of the month at 146 Chandler street.

Chicago Foundrymen's Club
Chicago

President, G. H. ROLINSON, American Brake Shoe & Foundry Co.; secretary, ALBERT N. WALLIN, S. Obermayer Co., 2563 W. Eighteenth street. Meetings second Saturday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, FRED W. STICKLE, Capitol Foundry Co., Hartford, Conn.; secretary, C. S. NEUMANN, Union Mfg. Co., New Britain, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association
Detroit

President, J. J. BOLAND, Griffin Wheel Co., Detroit; secretary, ROBERT HOPE, Holley Carburetor Co., Detroit. Meetings third Thursday in each month at the Union League club, 35 Grand River avenue, Detroit.

East Bay Foundrymen's Association
Oakland, Calif.

Secretary, H. L. MARTIN, Marchant's Foundry Co., 4401 East Tenth street, Oakland, Calif.

Metropolitan Brass Founders' Association
New York

President, WILLIAM EMBER, Jefferson Brass Foundry, 62 Delevan street, Brooklyn, N. Y.; secretary WILLIAM E. PAULSON, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 34 West Thirty-third street, New York.

Newark Foundrymen's Association
Newark, N. J.

President, J. L. CARTER, Barlow Foundry Inc., Newark; secretary, W. H. MANTZ, Atlas Foundry Co., Irvington, N. J. Meeting called by president.

New England Foundrymen's Association

President, HENRY S. CHAFEE, Builders Iron Foundry, Providence, R. I.; secretary, FRED F. STOCKWELL, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio State Foundrymen's Association

President, C. C. SMITH, Toledo Steel Casting Co., Bancroft and Smoad avenue, Toledo, O.; secretary-manager, ARTHUR J. TUSCANY, 5713 Euclid avenue, Cleveland.

Philadelphia Foundrymen's Association
Philadelphia

President, WALTER WOOD, R. D. Wood & Co., Philadelphia; secretary HOWARD EVANS, Union League club, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Southern Metal Trades Association
Atlanta, Ga.

President, GEORGE B. COCKER, Gastonia, N. C.; secretary, W. E. DUNN JR., Healy building, Atlanta, Ga.

Pittsburgh Foundrymen's Association
Pittsburgh

President, C. D. CAREY, American Steel Foundries, Pittsburgh; secretary-treasurer, WILLIAM J. BRANT, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August, at Fort Pitt hotel.

Quad-City Foundrymen's Association
Davenport, Iowa

President, HYMAN BORNSTEIN, Deere & Co., Moline, Ill.; secretary-treasurer, H. A. DEANE, Deere & Co., Moline, Ill. Meetings the third Monday of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

Tri-City Technical Council
Moline, Ill.

Chairman F. V. SKELLEY, Tri-City Railway Co., Rock Island, Ill.; treasurer, MAX SKLOVSKY, Deere & Co., Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association
Cincinnati

President, HAROLD P. RITTER, John A. Oberhelman Foundry Co., 3323 Colerain avenue; secretary, GEORGE W. PIEHL, Wessling Bros. Foundry Co., 1607 McLean avenue. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association
Minneapolis-St. Paul

President, H. H. NOTT, Smith System Heating Co., Minneapolis; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, south, Minneapolis. Meetings monthly at the Athletic club.

Washington Foundrymen's Club
Seattle

President, RONALD KUCHER, Olympic Foundry Co., Argo Station, Seattle; secretary, EDWARD C. GUSTIN, The Prescott Co., 1 West Lander street, Seattle. Meetings second and fourth Tuesdays of each month at the Elks' Temple, Fourth avenue and Spring street.

Obituary

William B. Greene, president, Acme, Palmer & DeMooy Foundry Co., Cleveland, died suddenly at his home in that city Sept. 28. Mr. Greene, who also was a director of the Ohio Electric & Controller Mfg. Co. and a member of the board of governors of the American Plan association, has been active in civic and industrial affairs in Cleveland since 1898. Previous to that time he was cashier, Potters National bank, East Liverpool, O., for eight years and president of a pottery enterprise in Leetonia, O. He was born in Lisbon, O. 65 years ago. Mr. Greene's connection with the foundry business dated back to 1898 when he removed to Cleveland and became secretary-treasurer of the Palmer & DeMooy Foundry Co. During his years of activity he served as president of the Cleveland Founders association and for several years was chairman, Ohio district, National Founders association. He became president of the Acme, Palmer & DeMooy Foundry Co., on the consolidation of the older concern with the Acme foundry in 1919. Mr. Greene is survived by his widow and his daughter, Mrs. Edna D. Price.

WILLIAM B. GREENE

William Thomas Palmer, aged 52, superintendent of the foundry, Tennessee Coal, Iron & Railroad Co., Westfield, Ala., died recently in Birmingham. He had been affiliated with the company for 35 years. He was interested in many community activities in the immediate vicinity.

Eurhans Vansteenbergh died Sept. 14 at his home in Goshen, N. Y., at the age of 79 years. In the early nineties Mr. Vansteenbergh built a plant at Goshen for the manufacture of gas appliances which now is occupied by Jay H. Newbury & Son who operate it as a pipe fittings foundry.

Peter J. McNamara Jr., aged 45 years, general superintendent, McNamara-Koster Foundry Co., Indianapolis, died at his home Sept 19. His father is president of the foundry company.

Will F. Francis, associated with the Thompson-Francis Stove Co., Gallipolis, O., died recently at the age of 72 years.

John T. Kelly, organizer of the Kelly & Jones Co., Greensburg, Pa., manufacturer of brass and iron fittings, and valves, died at his home in Scarsdale, N. Y., recently at the age of 74 years. Mr. Kelly organized the firm in 1872 and established branches in several cities. He was active head until 1925 when the company was purchased by the Walworth Co., Boston. Mr. Kelly was born in Allegheny, Pa.

Howard Snyder, inventor and vice president, Maytag Co., Newton, Iowa, died recently at the age of 58 years.

Charles W. Crawford pioneer manufacturer of Brazil, Ind., and organizer of the Crawford-McCrimmon Machine Shops & Foundry, died at his home recently at the age of 91 years.

Frank Ellsworth Lamson, vice president, Sessions Foundry Co., Bristol, Conn., died suddenly at his home, Sept. 7. He was born 66 years ago and entered the employ of the Sessions Foundry Co. as a shipping clerk in 1882. He held that post until 1919, when he was made traffic manager.

John B. Kennedy, president, English & Mersick Co., hardware manufacturers, New Haven, Conn., died at that place on Sept. 9. Mr. Kennedy formerly was a major in the second company, Governor's Foot Guards.

William Chamber, affectionately known either by sight or reputation to thousands of foundrymen throughout the country as "Uncle Billy" died Sunday, Sept. 25 after a short illness at his home in Chicago. Since 1922 "Uncle Billy" had been a partner and director with Henry Crown in the Material Service Corp., Chicago, representing producers of sand, firebrick and building materials. Despite the fact that he was 83 years old on July 7 this year, he continued as a traveling salesman for his company and was active up to three or four days before his death.

"Uncle Billy" was born in England, July 7, 1844 the son of a foundryman and ironworker. After the usual fashion of the time and place, the boy learned the trade of his father and then emigrated to the United States at the age of 25. He settled first in Philadelphia where in a small foundry in that city, he made some of the first steel castings ever produced. About 35 years ago he moved to Chicago where he helped to start the Chicago Crucible Steel Casting Co. This plant later was sold to the Gould Coupler Co. Afterward, in turn he started steel plants in Montpelier, Converse and Peru, Ind.

WILLIAM CHAMBER

In 1898 "Uncle Billy" abandoned the operating end of the foundry industry and became identified with the Garden City Sand Co., in the production and sale of molding sand. He remained with this company until 1922, when he helped to organize the company with which he remained until the time of his death. He was a familiar figure at all conventions of the American Foundrymen's association where his genial personality constantly added to his wide circle of friends and ecquaintances.

The late Mr. Chambers is survived by one son in Milwaukee and by a stepson and stepdaughter with whom he made his home in Chicago since the death of his wife a year and a half ago; also by three great grandchildren and a number of other relatives in Vincennes, Ind., and in England. The funeral services were held in Chicago, Sept. 27.

Three Ton Lift Truck Has Electric Drive

The Yale & Towne Mfg. Co., Stamford, Conn., has added a 3-ton high lift, elevating truck to its line of industrial trucks. The frame work consists mainly of a large gusset plate, ½-inch thick, and extending from the forward end of the truck to the small or trailing wheels. This plate is approximately 24 inches in height, at driving wheel axle and in addition to forming the frame work, provides a yoke to serve as a guide for the drive unit and the spring suspension of the truck.

The elevating platform is raised and lowered through a 1½-inch diamond roller chain, passing over a power-driven sprocket at the bottom, and an idler sprocket at the top. Heavy duty roller bearings made by the Hyatt Roller Bearing Co., Detroit, are employed in the idler sprocket at the top of the machine. The two ends of the roller chain are attached to the platform through a spring take-up device, which will adjust itself automatically as the chain wears.

The hoisting motor is connected to the spur-gear pinion through a spring ratchet, so arranged that a positive drive is obtained when raising the elevating platform. However, if the platform is checked in its downward travel, the ratchet merely will release, and cause no injury to the mechanism of the truck. The ratchet when slipping makes considerable noise, so that the operator is warned immediately of the fact that the truck platform is bearing on some obstruction. A speed of 7½ feet per minute is obtained when lifting a full load, and a speed of 19 feet per minute when raising the empty platform. The lowering speed is 19 feet per minute loaded or empty.

The elevating platform is supported by four rollers bearing on the inside of the flanges of the vertical ship channels. These channels have a depth of 9 inches and a flange of 3½ inches, so that a relatively large diameter roller, with a wide face, is possible. The rollers are equipped with roller bearings, and with a hardened steel thrust washer to take whatever end thrust when lifting loads that are not placed on the center line of the platform. The platform has an overall width of 27 inches, a height of 11 inches and a length of 54 inches.

The main drive unit is of the double reduction spur-gear type, driving the wheels through totally enclosed universal joints. The entire gear reduction with its differential and bearings run in a bath of oil.

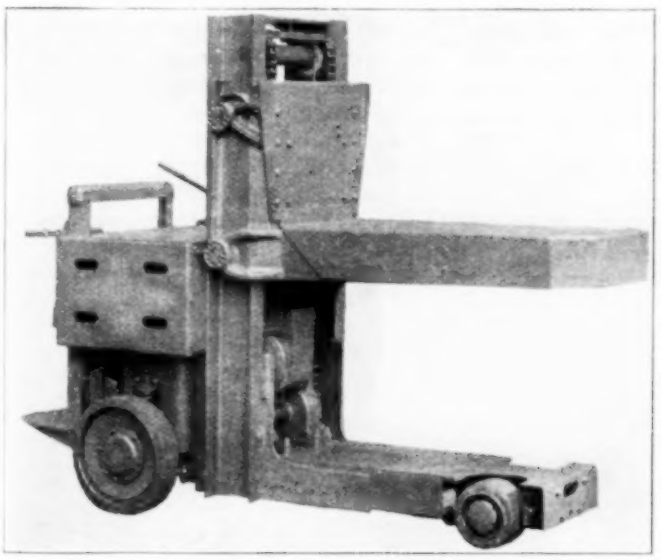
The steering knuckle king pins have been fitted with ball and roller thrust bearings. On the small wheels, which come directly beneath the load, the steering knuckle king pins, in addition to being fitted with the roller thrust bearings, also are equipped with an upper and lower roller bearing to take the radial load. These small wheels are fitted with roller bearings on all the moving parts and each wheel assembly contains five bearings. A four wheel steer feature allows a turning radius of 96 inches to the outside edge of the truck. Main features of the truck may be noted in the illustration to the lower left.

Designs Squeezer Machine

The Tabor Mfg. Co., 6225 Tacony street, Philadelphia, recently has introduced a new post type squeezer molding machine. This machine, which is shown in the accompanying illustration, has been developed and built with consideration for economic operation, speed and durability. The table of the machine, 16 inches wide and 19 inches deep, will accommodate all flasks that would be considered for machines of his type. The squeezing cylinder is 10 inches in diameter and is located above the table of the machine. This cylinder may be swung quickly into and away from the squeezing position by a handle conveniently located on the squeezing head. The same handle controls the squeezing operation by a slight downward pull on the part of the operator.

The new squeezer machine is supplied in both the plain squeeze and jar squeeze types. It also may be supplied either stationary or portable and an additional portable design with a wheel-base that will straddle a sand heap 19 inches high and 60 inches wide also is offered. Each machine is equipped with vibrator, pressure gage and blow valve.

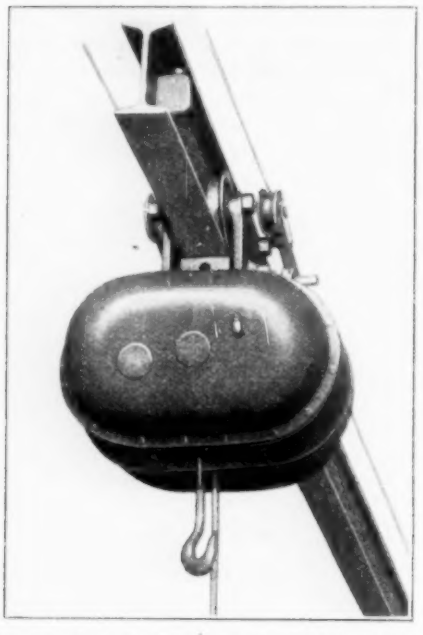
George F. Crivel & Co. Inc., 614 Ellicott Square, Buffalo, has been appointed to represent the American Foundry Equipment Co., Mishawaka, Ind., in the Buffalo territory. George F. Crivel, the president of the organization, has been associated with the Whiting Corp., Harvey, Ill., and later the J. W. Paxson Co., Philadelphia, and has had wide experience in the foundry supply and equipment lines.



ABOVE, ROLLER BEARINGS ARE USED ON MOVING PARTS THROUGHOUT THE TRUCK. RIGHT, THE SQUEEZING CYLINDER IS ON THE POST. THE CONTROL VALVES ARE ON THE SQUEEZER HEAD

Designs Small Hoist

The American Engineering Co., Philadelphia, recently has introduced a new high speed type, all steel, ¼-ton electric hoist. The hoist is constructed with chrome-manganese steel



THE HOIST TRAVELS AT A HIGH SPEED

gears and shafts, ball bearings, oil bath lubrication, push button control and upper and lower limit switches. All working parts are completely enclosed. The hoist weighs 200 pounds and is made in two types, namely with a plain trolley or with hook suspension. The plain trolley type requires a 16-inch headroom and the hook suspension type an 18-inch headroom.

Makes Adjustable Dowels

The Kindt-Collins Co., 12697 Elmwood avenue, Cleveland, recently has introduced an adjustable master dowel designed for metal patterns and core boxes where a long pin and perfect bearing is required. The pin is tapered at the bearing point and may be adjusted to fit exactly the taper on the opposite bushing without any shift. The adjustment is made simply by turning the pin. The threads inside the collet and on the pin raise and lower the pin to the length required for the proper bearing.

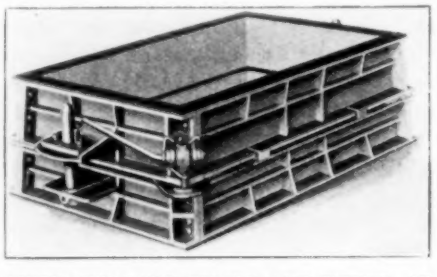
After the pin has been adjusted, the nut on the collet is tightened, thus holding the pin and collet in place firmly. The pin may be cut off at any length desired. The bushing and the collet are easily alike in outside measurements and shape.

The dowel may be inserted simply by boring a straight hole 1-16-inch smaller than the reamer. The reamer then cuts the hole to the exact size required, thus giving both parts a perfect bearing. The same tool is used to cut the seat for the tapered flange. The dowels are made in a number of sizes.

Makes Aluminum Flasks

T. B. Wood's Sons Co., Chambersburg, Pa., recently has introduced an aluminum flask which embodies a number of interesting features also incorporated in a wooden flask made by that company.

These flask are made with cast aluminum sides, which are finished carefully to insure a flask of accurate size. They are made with top and bottom flanges on both cope and drag and are well ribbed vertically and horizontally to avoid any tendency of flask springing or bending. In addition, steel wearing strips are fitted at the top of the cope and the bottom of the drag, which reinforce and stiffen the flanges and also provide for wear. Bronze sand strips of a new design are fitted to these



STEEL WEARING STRIPS ARE FITTED AT TOP AND BOTTOM

flasks and are controlled by a simple but positive operating mechanism. When the flask is to be stripped from mold a slight pressure on the finger levers draws the sand strips flush with the sides of cope. The strips are returned automatically to the normal position when the levers are released.

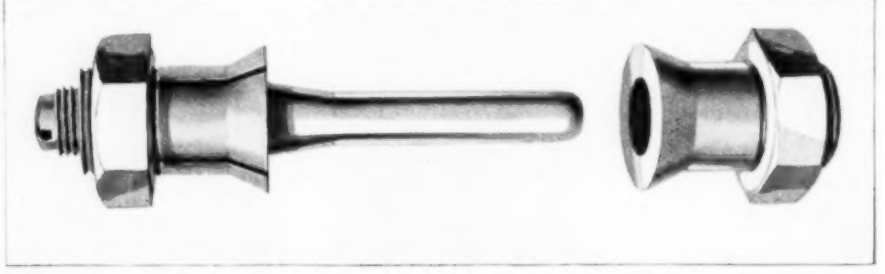
The tapered aluminum slip flask is made in even inches of width and length from 10 x 10 to 20 x 24 inches. The size of flask is measured inside at the parting line at the top surface of the drag. Copes are supplied 3½, 4, 4½, 5, 5½, 6, 7, and 8 inches deep. Drags are supplied 2½, 3, 3½, 4, 4½, 5 and 6 inches deep.

Cope and drag lugs are cast integral with end pieces and drags are drilled and fitted with ¾-inch round pins. The cope guides are so designed that they give a large bearing surface on the pin and insure a straight draw. Provision is made for adjusting the guides to compensate for wear. In addition to the standard ¾-inch round pins, these flasks also may be fitted with any other type of flask pin. An adjustable slip jacket, also manufactured by that company, may be used in connection with both the aluminum and wooden flask.

Electric Motor Drives

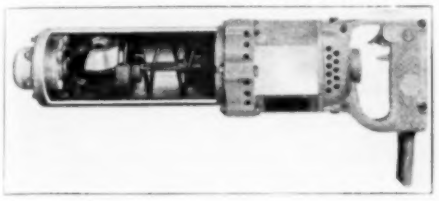
The Black & Decker Co., Towson, Md., recently has developed an electric hammer. The motor in this hammer is the same type as used in the line of electric drills made by that company with the exception of a few minor refinements. It is a universal motor operating on direct current or alternating current from 25 to 60 cycles and operates efficiently on voltages 10 per cent above or below voltage shown on the name plate. The armature of this motor turns at approximately 10,500 revolutions per minute and is equipped with an aluminum centrifugal fan which draws air in at the commutator end of the motor. The armature shaft is hollow to accommodate the spline shaft upon which the reciprocating hammer mechanism is mounted. This reciprocating mechanism, which actually strikes the blow, is made up of a special forging upon which are mounted the two beveled gears heavily weighted on one-half of their area. These gears are driven by a beveled pinion on the spline shaft, and consequently, rotate in opposite directions.

When the two weights are together at the bottom, the whole reciprocating mechanism mounted on the spline shaft moves downward, striking a heavy blow on the oil-tight piston



THE PIN AND THE BUSHING ARE TAPERED AT THE BEARING POINT

which transmits the blow to the drill or cutting tool being used. When the two weights come around together at the top the reciprocating mechanism travels up with equal force but, instead of striking a similar blow at the upper end of the



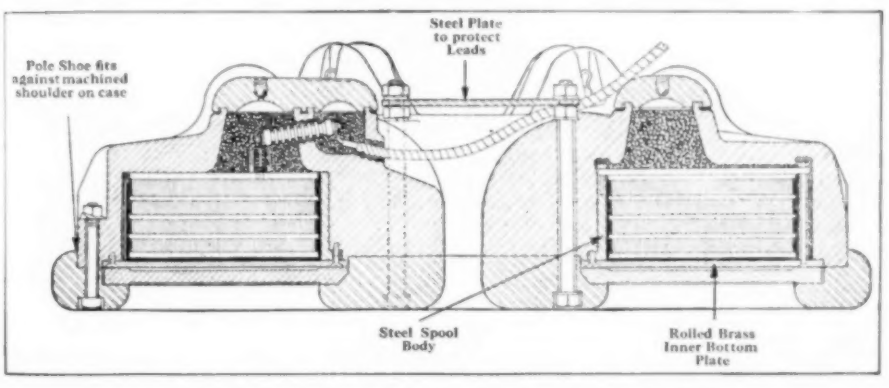
SHOCKS ARE NOT COMMUNICATED TO THE MOTOR

stroke, this blow is absorbed by the coil spring.

The spline shaft carrying the reciprocating weights is driven by the motor through a centrifugal coupling instead of direct and all shocks which may be caused by the reciprocating mechanism are absorbed through a flexing of this centrifugal coupling instead of being communicated to the motor. This piston is supported by a heavy coil spring which absorbs the hammer blow when it is running idle. When the hammer is working, this spring is rendered ineffective and does not absorb any of the blow. The hammer strikes 2300 blows a minute. The working mechanism operates in a bath of oil and is sealed against dust and grit.

Makes Changes in Magnet

The Electric Controller & Mfg. Co., 2700 East 79th street, Cleveland, has made a number of improvements on its line of lifting magnets. The new magnet has a coil spider of composite construction with a body of cast steel and a flange of cold rolled brass. The outer pole shoe extends upward to fit against a machined surface on the outside of the magnet housing, which it is claimed gives greater strength to prevent pole shoe breakage. A steel plate ½-inch thick is bolted in place at the top of the magnet to prevent injury to the incoming wires from the crushing effect of crane hook and chains. The changes made in the design of the magnet may be noted in the sectional view shown in the accompanying illustration.


Steel Plate to protect Leads
Pole Shoe fits against machined shoulder on case
Steel Spool Body
Rolled Brass Inner Bottom Plate

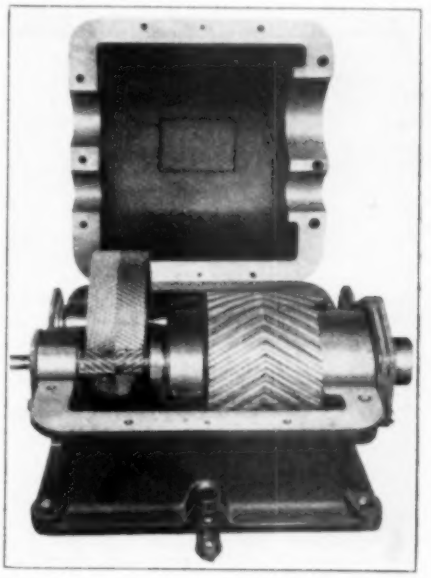
SECTIONAL VIEW OF NEW TYPE LIFTING MAGNET

Steel Pipe Is Tinned

Question: Do you know of any better method for preparing steel pipe for use in a mold for an iron casting, than by tinning the outside and filling the inside with silica sand?

Answer: We might answer that question by the single word, no, but since local conditions sometimes exert a bearing on the question, it may be advisable to expand that simple answer a little. In a great many cases it is not necessary to fill the tubes with sand and in many other cases it is not even necessary to tin the outside. The shape and size of the casting, the thickness of metal, the temperature at which the metal is poured and the position of the gate must be taken into account.

Where a perfect union is required between the pipe and the iron in the casting the pipe should be tinned. Where this feature is optional, that is where a partial fusion and the contraction of the metal are sufficient to hold the pipe in place, no tinning is necessary. Provided the pipe is clean, free from scale and lightly anointed with oil to prevent it from becoming damp, that is all that is required. In the majority of instances steel pipe will hold its shape in a mold without being filled with sand. No specific rule can be laid down to determine the safety point in this respect. Information gained from actual experience is the only guide for a foundryman. If you had submitted a specific problem, showing the casting and pipe we could have advised you definitely on whether it is necessary to either tin the pipe or fill it with sand. For your general information it may be stated that steel pipe coils cast in the various cooling devices used around blast furnaces and open hearth furnaces, are neither tinned nor filled with sand before they are placed in the molds.



HERRINGBONE SPEED REDUCER WITH GEARS EXPOSED

Has Herringbone Gears

The Link-Belt Co., 910 South Michigan avenue, Chicago, recently has announced a herringbone gear speed reducer which it is claimed combines the advantages of quietness of operation, high efficiency and the ability to withstand shocks. Three standard units have been developed to cover a wide range of capacities and ratios. The single reduction unit covers ratios up to 10 to 1. The second type is designed for heavy duty and ratios from 10 to 1 to 80 to 1. The third type is a light duty reducer with ratios ranging from 10 to 1 up to 130 to 1.

Teeth of the herringbone gears run continuously across the face of the gear. This gives a good bearing surface with several of the teeth engaged. The pinions are heat treated alloy steel cut integral with the shaft. The unit is designed with a small number of parts and with roller bearings throughout. Gears rotate within a large oil reservoir and bearings are splash lubricated. Special oil baffles at shaft projections keep the dust out. Rigid construction insures proper alignment of parts.

Yellow brass, S. A. E. specification No. 41 has the following composition: Copper, 62.00 to 65.00 per cent; lead, 2.00 to 4.00 per cent; zinc, 31.00 to 36.00 per cent; tin, max. 1.00 per cent; iron, max. 0.50; aluminum, none; other impurities, 0.25 per cent.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Crompton & Knowles Loom Works, Worcester, Mass., will start a mill addition.

Ben W. Frieden, Fort Worth, Tex., plans to build a stove plant, brick construction.

Baker Stove Co., Belleville, Ill., was damaged by a recent fire.

McCormick Foundry Co., Folsom and Main streets, San Francisco, will rebuild the part of its iron foundry damaged by a recent fire.

Doehler Die Casting Co., Batavia, N. Y., contemplates rebuilding its plants to remove the present fire hazard.

Lavelle Foundry Co., Anderson, Ind., will rebuild that part of its plant which was damaged by a recent fire.

A. V. Moore Brass Works, Norfolk, Va., has been incorporated with $50,000 capital by A. V. Moore, 1432 Princess Ann road.

Anchor Stove & Range Co., New Albany, Ind., suffered damage to its foundry when it burned recently.

Henter Corp., Silver Creek, N. Y., has leased space and will manufacture die cast specialties.

Michigan Steel Castings Co., 1986 Guion street, Detroit, contemplates building a 1-story foundry addition.

Auto Stove Works, New Athens, Ill., George Wirth Jr., secretary and treasurer, will build a 2-story stove factory.

Bassick Co., Center and Brittania streets, Meriden, Conn., will soon award the contract for a 2-story plant, 60 x 150 feet and 75 x 100 feet, for the manufacture of casters.

Sterling Grate Corp., Lafayette, Ind., has been incorporated with 15,000 shares no par value to manufacture iron and steel products by C. F. Boyer and A. B. Dick.

Weil-McLain Co., 641 West Lake street, Chicago, maker of boilers, heating equipment, etc., has purchased additional property and will use it for future expansion.

American Casting Co., 6835 South Irving avenue, Chicago has awarded the general contract for a 1-story foundry building 72 x 125 feet to McAver Bros., 7940 Prairie avenue.

Frederick Corp., Boston, has been incorporated with $10,000 capital to operate mills, shops, forges and foundries by Henry I. Fitzgerald, 11 Gerald Road, Brighton, Mass.

Chatham Malleable Steel Co., 178 Inches avenue, Chatham, Ont., will start work immediately on an addition to its foundry. F. C. Nicholson, Tilbury, Ont., is general contractor.

Hardie-Tynes Mfg. Co., Birmingham, Ala., machine shop and foundry was damaged by a recent fire. A new pattern shop is being constructed to replace the fire loss.

M. & H. Valve & Fittings Co., Anniston, Ala., L. C. Watson, secretary, has increased capital from $300,000 to $347,000 to cover recent enlargements of its plant.

J. A. Zurn Mfg. Co., Forteenth and German streets, Erie, Pa., maker of plumbing equipment, plans to build a new works, including a foundry and pattern shop, machine shop.

Sloan Valve Co., Chicago, W. E. Sloan, president, 4300 West Lake street, has awarded the general contract for a 1-story power house addition to Thorgersen & Erickson, 4804 North Kedzie avenue.

Worthington Pump & Machinery Corp., New York, has centralized its diesel engine building activities at the Snow Works at Buffalo, and has discontinued its operation of the Blake & Knowles Works at Cambridge, Mass.

Thomas Savill's Sons Inc., Philadelphia, has been incorporated with $5000 capital to manufacture plumbing, gas and steam fittings etc., by Robert G. Savill, Essex and Sabine avenue, Narberth, Pa.

Mountville Mfg. Co. Inc., Mountville, Pa., has been incorporated with $66,000 capital to manufacture agricultural implements by Will S. Martin, C. M. Kendig and Edward I. Froelich.

Canadian Westinghouse Co., Ltd., Hamilton, Ont., will erect a brass foundry as an addition to its west end plant. Structural steel required will be supplied by the Hamilton Bridge Works.

Hamilton Gear & Foundry Works Ltd., 76 Van Horne street, Toronto, Ont., has awarded the steel contract for an addition to its plant to McGregor & McIntyre Ltd., 1138 Shaw street.

Lisle Co. Ltd., Windsor, Ont., has been incorporated to carry on the business of brass founder and engineer with $40,000 capital by Leigh H. Snider, Louis H. Swartz, Corrine E. Gignac.

S. O. M. Mfg. Co. Inc., Pittsburgh, has been incorporated with $6000 capital to maintain a foundry and machine shop by A. C. Stickel, F. W. Ofeldt, and W. C. McElheny, 5527 Forbes street, Pittsburgh.

Beaver Falls Steel Co., Beaver Falls, Pa., has been incorporated with $180,000 capital to manufacture steel, iron and alloy castings by Max Solomon, H. C. Perrott and A. D. Campbell.

American Furnace Fitting Co., 410 North Western avenue, Chicago, has been incorporated with $14,000 capital to manufacture elbows, boots, stacks and furnace accessories, by Nelson & Ricker, 616 Burnham building, 160 North LaSalle street, correspondents.

Ideal Specialty Mfg. Co., Royersford, Pa., has been incorporated to take over the plant of the Ideal Foundry & Machine Works and will make a general line of gray iron, brass and aluminum castings for the plumbing and heating trade.

Philadelphia Lawn Mower Co. Inc., Philadelphia, has been incorporated with $150,000 capital to manufacture lawn mowers and landscape implements by Hermann M. Hessenbruch, Edward L. Davis and Lewis M. Stevens.

Lunenburg Foundry Co., Lunenburg, N. S., has started work on an addition to its plant to increase the facilities for manufacturing marine engines, stoves, furnaces, ranges, etc. The extension will provide 5400 square feet additional floor space.

Keystone Foundry Co., Plymouth, Ind., has been sold to the Argos Foundry Co., Argos, Ind., by Chase Smelser, receiver, for $401 for the equity and the buyer to assume the taxes and a $10,000 mortgage. John H. Miller is principal owner of the Argos company.

Superintendent of Blue Island, Ill. schools, J. E. Lemon, announces plans to add a foundry and pattern shop to the new high school.

Galion Iron Works & Mfg. Co., Galion, O., has plans under way for an assembly plant for road graders, as part of an expansion program.

George A. MacKenzie & Co. Ltd., Calgary, Alta., has been incorporated to carry on the business of oil producers and refiner, and operator of foundries, coal mines, coke ovens iron and steel mills, with $200,000 capital and 4000 shares no par value, by Harold A. Jacques, Blanche Lott and Edna Allen.

Kingston Products Corp., Kokomo, Ind., has been formed by the merger of the Kokomo Brass Works, Byrne-Kingstone Co., and the Kokomo Electric Co. Paul Johnson is president and general manager, and Frank C. Ryan, Chicago, is secretary and treasurer. The entire common stock is owned by the Johnson and Ryan families.

Birmingham Iron Foundry, Derby, Conn., manufacturer of special machinery and rolls for rubber mills, and the Farrel Foundry & Machine Co., Ansonia, Conn., manufacturer of heavy mill machinery, have consolidated under the name of Farrel-Birmingham Co. Inc. The new company has a capital of $5,700,000. The following officers have been elected: Charles F. Bliss, president; F. D. Wannings, Walter Perry and Franklin Farrel Jr., vice presidents, and George C. Bryant, secretary. The plants will continue to operate independently for the present. (Noted Sept. 1).

Equipment of the Tioga Steel & Iron Co. and the Philadelphia Roll & Machine Co. is being moved from the present plant of these firms at Philadelphia and is being installed at the William Wharton Jr. & Co. plant at Easton, Pa. It is expected that the transfer will be completed before the end of the year, at which time the Tioga and Philadelphia Roll companies will be in full operation at Easton. Products of these firms include iron castings, rolls, rolling mill machinery, etc. All three firms mentioned are subsidiaries of the Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

Foote Bros. Gear & Machine Co., Chicago, has acquired and will operate the A. Plamondon Mfg. Co., also of Chicago. The Plamondon company was organized in 1857 and has been manufacturing cast gears. In the purchase of the company, the Foote Bros. organization will acquire foundry facilities to make castings now bought on the open market. The personnel will be retained by the new management, it is stated. To effect the purchase, the Foote Bros. company increased its common stock from 80,000 shares to 120,000 shares of $5 par value.

New Trade Publications

ELECTRIC CONTROL—Allen-Bradley Co., Milwaukee, has issued a folder describing its push button control for motors up to 2 horsepower.

MOTORS—Century Electric Co., St. Louis, has published a pamphlet giving various features of construction of its repulsion-start, induction motors.

FOUNDRY FLUX—Mathieson Alkali Works, Inc., New York, has published a 4-page bulletin describing results obtained and directions for using its alkali flux in refining malleable iron.

MATERIAL HANDLING EQUIPMENT—Cleveland Electric Tramrail, division of Cleveland Crane & Engineering Co., Wickliffe, O. has issued a folder explaining the newly designed tramrail, and presenting illustrations comparing the strength of the rail to I-beams. Tables showing comparative strengths are also included.